BONDED ABRASIVE PRIMER

Basic information on the terminology and use of bonded abrasive products.

Property of:

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BONDED ABRASIVES

GENERAL

Bonded abrasives are manufactured in a wide variety of sizes and shapes, among the most popular items being:

Type 27 and 28 depressed center grinding wheels

Type 1 cut-off wheels from 1" diameter to 36" and larger

Type 1 grinding and snagging wheels

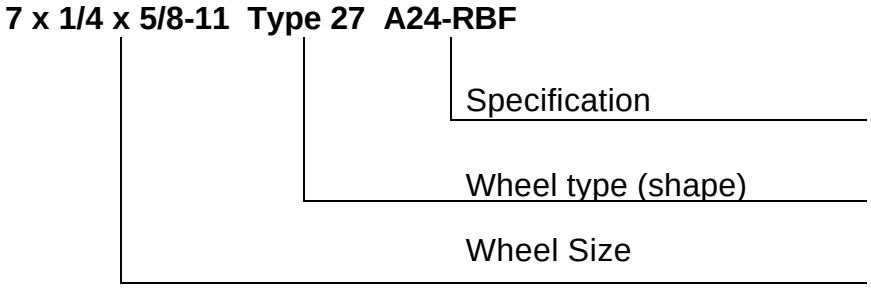
Type 11 flared cups

Types 16, 17, & 18 plugs and cones

Resin bonded abrasives a held together with glue like phenolic resins, whereas vitrified abrasives are a fired ceramic bond. In general resin bonded abrasives are tougher and stronger than vitrified products. They are frequently used for offhand grinding and heavy duty cut-off applications. Vitrified abrasives see their greatest use in precision grinding.

BASIC WHEEL IDENTIFICATION SYSTEM

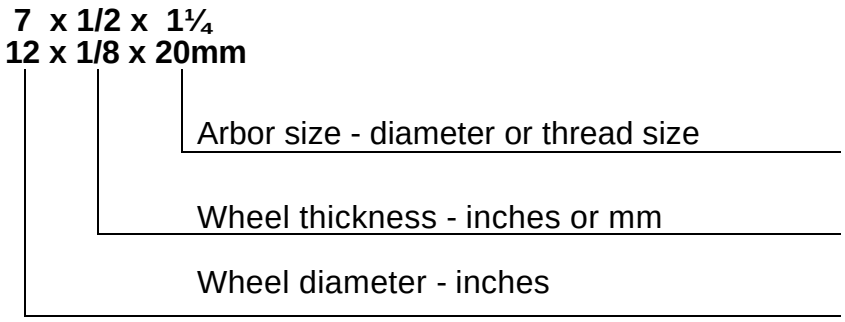
All resin bonded abrasives are identified using the following basic measurements and information:



WHEEL SIZE

Wheel sizes are expressed by three measurements that are always expressed in the same order:

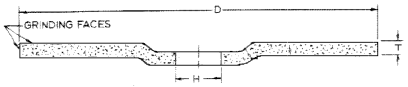
Diameter x Thickness x Arbor



COMMON WHEEL TYPES

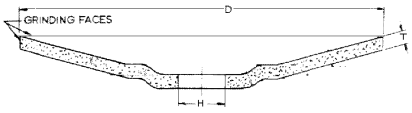
TYPE 27 DEPRESSED CENTER WHEELS

A flat disc with a recessed or depressed center section. Used on right angle grinders for weld grinding, heavy stock removal, and some cut-off operations. Wheels 1/4" thick are the most common, and are used for the grinding. Wheels 1/8" thick are used for light grinding and cut- off, frequently in pipe fabrication work. Standard wheel diameters run from 3" to 9".



TYPE 28 DEPRESSED CENTER WHEELS

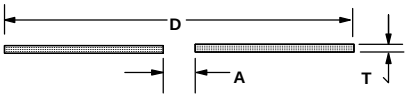
Similar to Type 27 wheels above except that the wheel is dished in a concave shape. This configuration allows it to be used at a flatter or lower angle to the work. They are frequently used for rough surface grinding applications. T-28 wheels are not nearly as popular as T-27, and are available in 7" and 9" only.



TYPE 1 CUT-OFF WHEELS

Type 1 wheels are flat discs. Most cut-off wheels have a thickness of 1/4" or less. Diameters range from 1" to 36" or larger. Some common Type 1 cut-off blades include:

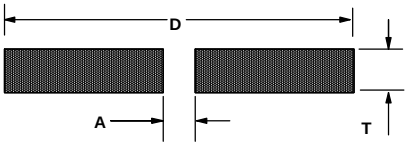
- 1" to 4" die grinder wheels
- 7" & 8" portable saw blades
- 12" & 14" gas saw blades
- 12" to 20" street saw blades
- 6" to 36" stationary metal saw blades
- 2" to 20" masonry table saw blades



TYPE 1 GRINDING WHEELS

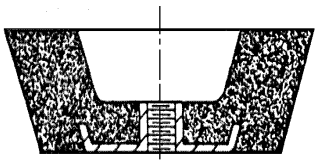
When Type 1 wheels are 1/2" or thicker, they are usually used for grinding on edge. Typical applications include

- Bench grinding wheels
- Straight grinding wheels for hand held tools
- Snagging wheels for stationary tools



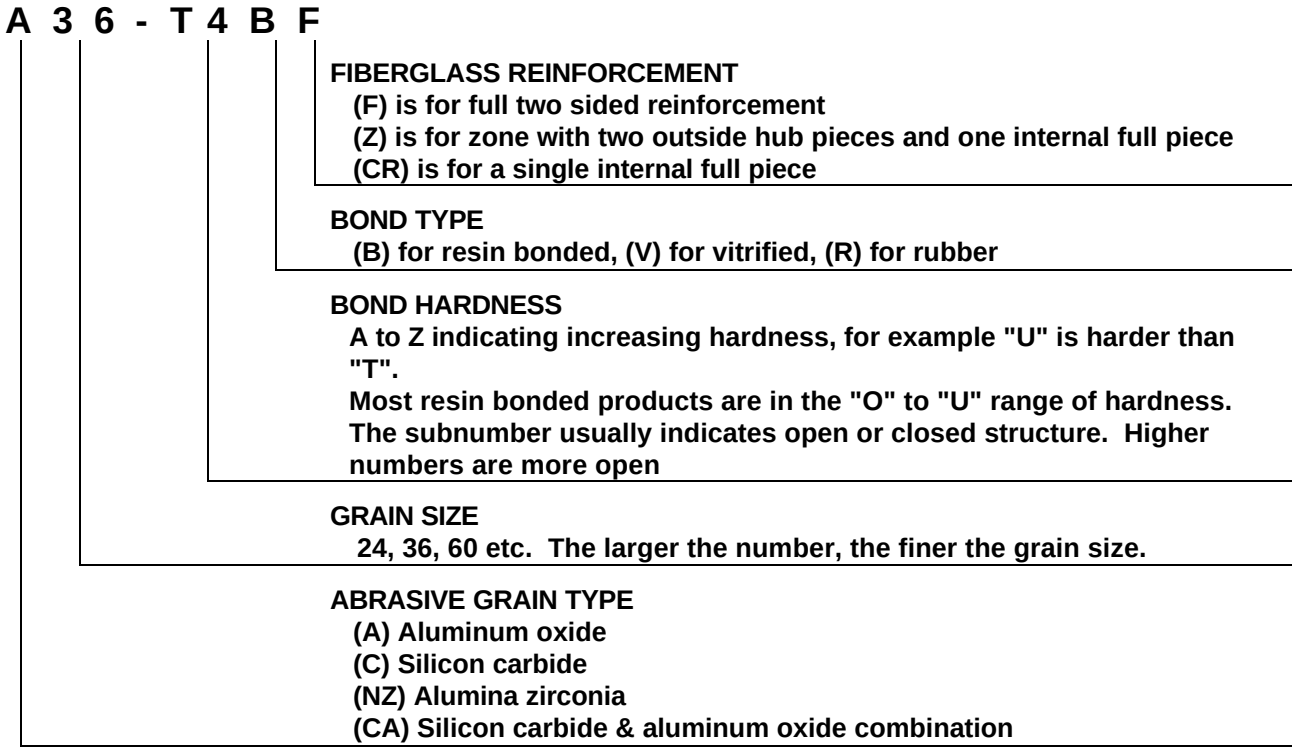
TYPE 11 FLARED CUPS

Flared cups are shaped as shown on the right, and are used for heavy stock removal with right angle grinders. Prime applications include foundry work, metal fabrication, and shipbuilding. They are also used in concrete surfacing.



SPECIFICATION FORMAT

While specifications for resin bonded abrasives can vary significantly, there is a common outline that is present in most cases.



ABRASIVE GRAIN TYPES

ALUMINUM OXIDE is the primary metal grinding and cutting grain. It is a tough, durable grain that works well with most ferrous metals and stainless steels. Most T-27 wheels are made with aluminum oxide for metal grinding.

SILICON CARBIDE is the primary masonry and nonferrous grinding and cutting grain. It is sharper than aluminum oxide, but is more brittle. All concrete and masonry cutting wheels are made with silicon carbide. It is also used to cut or grind nonferrous metals like aluminum and some cast iron materials.

ALUMINUM ZIRCONIA is a refracturing grain where the individual grain particles break during use to present new cutting edges. Alumina zirconia offers longer life and faster cutting on ferrous and stainless steels when compared to aluminum oxide. It is a more expensive grain, but offers the user good value for the extra cost.

BOND TYPE

RESIN BOND uses phenolic resins to hold the abrasive grains in a shape. A mixture of abrasive grains and resins are pressed to shape, and then cured in ovens at a temperature of about 400 ^{o}F. Resin bonded wheels are tougher and stronger than vitrified, and used for offhand grinding (hand held tools) and all heavy duty applications.

VITRIFIED BOND uses natural clays to bind the abrasive grains into a ceramic bond. Vitrified wheels are fired at about 2,000 ^{o}F much like a pottery product. Wheels with this bond are typically used on stationary tools for precision grinding.

WHEEL HARDNESS

Hardness is the term that refers to how tightly the resin material hold on to the grain particles. A hard bond is one that is very strong and does not let the wheel breakdown quickly, thereby providing long wheel life. A soft bond is one that breaks down more quickly to expose new fresh grain particles to the work.
User must be aware that:

HARD WHEELS: *Last longer but may not cut fast or cleanly. They are generally used to cut or grind soft materials.*

SOFT WHEELS: *Cut fast and smooth, but do not last as long. They are generally used to cut or grind hard materials.*

Unfortunately users frequently want wheels that cut quickly and last forever. This is a difficult proposition, requiring compromise in the selection. It is also the reason most abrasive manufacturers offer a variety of hardness specifications in most products.

The hardness of the bond is expressed by a relative alphabetic scale with (A) being the softest, and (Z) being the hardest. Hardness numbers vary from one manufacturer to another, and the scale tends to be relative. Most resin bonded wheels have a hardness in the (O) to (U) range.

The selection of wheel hardness is directly related to the power of the tool. Low powered tools generally need soft wheels, while high powered tools require harder bonds.

SPEED RATINGS:

Wheel speed ratings in revolutions per minute (RPM) are based on both the safe limits of the wheel and the optimum grinding rate. Reinforced resin wheels frequently have a maximum allowable speed of 16,000 surface feet per minute (SFPM). Vitrified wheels always have a much lower allowable speed, usually no more than 9,500 SFPM. This is the speed that the edge of a new full diameter wheel moves past the work piece. To translate this into a RPM rating, we divide the allowable surface feet per minute by the wheel circumference (3.14 x diameter).

Maximum SFPM / Wheel Circumference (ft) = Maximum RPM

Abrasive wheels are designed to work best at speeds at or slightly below the maximum RPM. Higher or lower speeds will not enhance performance. Many wheels are operated at unsafe higher speeds under the misconception that they will cut faster. ***Under no circumstances should wheels be used with tools whose maximum speed exceeds the listed rating of the wheel. This also applies to tools that are governed or adjusted to a lower speed. Do not allow the maximum rated speed of the tool to exceed the wheel rating.***

WHEEL MOUNTING:

All abrasive wheels should be properly mounted per the manufacturers instructions and ANSI B7.1 guidelines. Most importantly, the mounting flanges should be of the proper sizes, clean, and sufficiently tight against the wheel. In general the mounting flanges for cut-off wheels should be 1/3 the diameter of the wheel diameter.

TROUBLESHOOTING

When users complain of problems with resin bonded abrasives, they usually can be attributed to one of the following causes:

The wrong application for the wheel being used.

The operator is not using the product correctly.

The wheel is being used on a tool other than for which it was designed.

The wheel is being used on the proper tool, but one that is worn or defective.

The wheel is defective.

WRONG APPLICATIONS

The most common problem with abrasives is the wrong product application . The use of cut-off and grinding wheels that are too hard is frequently encountered. Operators want long wheel life, and tend to opt for harder wheels than they should be using. If the wheel is too hard for the material being cut or ground, it will generate excessive heat causing wheel distortion or chipping. Excessive heat can cause cut-off wheels to not cut straight or produce too much burring.

Another common application problem is trying to use one wheel for every job. For example, silicon carbide abrasives are usually used on concrete/masonry materials and aluminum oxide on ferrous metals. Trying to use one wheel for both applications will result in poor results. Silicon carbide generally wears very fast on ferrous metals, while aluminum oxide glazes over on masonry. Using a grinding wheel designed for aluminum on stainless steel will not be satisfactory.

When application problems are suspected, refer to your abrasive manufacturer's catalog to check that you are using the right product for the material being cut and tool being used.

OPERATOR MISUSE

One of the most difficult problems to resolve is the misuse of abrasives by operators. Most operators are not receptive to being told that they are not using the product correctly. Some of the most common misuses encountered in the field are:

Using depressed center wheels too flat causing face wear rather than edge wear. T-27 wheels should be used at an angle of 15º or greater.

Not having the material being cut or ground properly clamped.

Excessive force or too little force with cut-off wheels.

USING WHEELS ON THE WRONG TOOL

All abrasive wheels are designed to be used on specific types of tools. The tool factors include: rotation speed, power, wheel flanges or attachment means, safety guards, and whether it is for fixed or offhand use. Using wheels on tools that provide appreciably different operation conditions from the recommended can cause serious safety problems and poor performance. Some common examples are:

Using wheels at higher than recommended speeds is very dangerous, and usually results in poor performance due to accelerated wheel breakdown.

Wheels designed for low power tools used on high power tools will breakdown to fast and not give adequate life. Also the reinforcement may not be adequate for higher power tool. Conversely, high power wheels on lower power tools will usually be too hard and not cut well.

Thin cut-off wheels used on right angle grinders can easily break due to excessive side stress.

DEFECTIVE TOOLS

A worn tool can make an abrasive wheel look like it is a poor or defective product. Some of the most frequently encountered problems include:

Bad bearings can cause excessive vibration or chattering.

Mounting flanges of uneven size can warp cut-off wheels, causing them to cut unevenly.

A worn arbor shaft can cause the wheel to mount off-center.

Loss of power due to motor or power transmission problems will cause the wheel to slow and not cut properly.

DEFECTIVE WHEELS

Defective abrasive wheels will occasionally be encountered. If after checking some of the above noted common application problems the wheel is still not performing properly, take it out of service and contact your manufacturer. Most abrasive manufacturers are sensitive to quality problems, and will quickly checkout the situation to resolve the problem. Before contacting the manufacturer, be certain that you have all of the pertinent facts about the wheel, tool, material, and operator technique.