Machining

Non-Woven Convolute Wheels For Cylindrical & Centerless Grinding

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Two types of grinding operations are commonly used to form the exterior shapes of round or nearly round objects or workpieces: cylindrical and centerless grinding. Cylindrical grinding (sometimes called centered grinding) is the most common grinding process, where the workpiece is rotated about a central axis, and material is removed from the workpiece using an abrasive wheel, or belt. Centerless grinding differs from cylindrical grinding in that the workpiece is not constrained to rotate about a fixed center. Rather, the workpiece is held between two rotary wheels, one of which is used as a guide, and the other being the grinding wheel that removes material from the workpiece. This article provides an overview of cylindrical and centerless grinding operations with a focus on how Norton non-woven convolute grinding wheel technology is ideally suited to these types of grinding and polishing applications.

Advantages and Disadvantages

There are certain advantages and disadvantages associated with cylindrical and centerless grinding operations. Cylindrical grinding is capable of grinding cylindrical and non-cylindrical workpieces, such as ellipses, cams and crankshafts, with a high degree of precision. However, since the workpiece must be held in place by a fixture, additional time and labor may be required to load and unload the workpiece. Centerless grinding, although constrained to grinding cylindrical workpieces, is faster and more efficient, since the workpiece is held in place by rotary wheels, eliminating the need for loading and unloading the workpiece into a fixture. This may make centerless grinding more productive than cylindrical grinding.

Figure 1.

Figure 2.

Figure 3.

Cylindrical and centerless grinding operations are performed using different types of abrasive wheels or belts, which fall into the general categories of bonded, coated and non-woven abrasives. A bonded abrasive wheel consists of abrasive particles that are pressed and bonded together into a round, solid shape by a cementing matrix or bond (Figure 1). Depending on the type of grain used, bonded abrasive grinding wheels are suitable for numerous applications, such as material removal, cutting, honing and polishing. Coated abrasives consist of abrasive materials that are adhered onto belts, sheets, discs or rolls with an adhesive (Figure 2). These products are highly versatile, and are used for heavy-to-medium stock removal, fine finishing, and light blending and polishing applications. Non-woven abrasives consist of three dimensional strands of flexible fibers, onto which abrasive grains are bonded, that are

pressed together to form sheets or cylinders (Figure 3). The choice of using a bonded versus a coated versus a non-woven abrasive in cylindrical or centerless grinding operations depends on numerous factors, such as the type and hardness of the workpiece, the amount of material that needs to be removed, the surface finish desired, the speed of the grinding operation, and the contact temperature between the workpiece and abrasive.

Non-woven abrasives have certain advantages when compared to bonded or coated abrasives. Their open structure can provide a continuous supply of fresh abrasive grains when the fiber or old abrasive wears away. Furthermore, in non-wovens the abrasives are held on fiber structures that are more compliant than bonded or coated abrasives, enabling them to be more “forgiving,” thereby reducing the likelihood of damaging the workpiece. Other advantages of non-woven abrasives include their durability and ability to maintain their shape longer, especially when the contact temperature is high during fast rotational speeds. This leads to less loading and a better finish than can be obtained with a bonded or coated abrasive. Non-woven abrasives are also waterproof and washable, and they can be used wet or dry.

Convolute Non-Woven Abrasive Wheels

Convolute non-woven abrasive wheels are created by starting with a sheet of non-woven fiber impregnated with abrasive grain, which is then wound around an axis or central core. As it is wound the layers are bonded together. When the desired wheel diameter is achieved, the adhesive is cured and the wheel is cut to the appropriate thickness. Because convolute wheels are wound in a certain direction, they can only be operated in that same directions to ensure they do not delaminate.

Non-woven convolute wheels can be used on the same cylindrical or centerless grinding machines that bonded wheels or coated belts can be used. However, non-woven convolute wheels would not be used when significant material removal is required. Convolute wheels will provide a better surface finish and can minimize the risk of damage to the workpiece, such as scratching or burning. Typical applications for non-woven convolute wheels could be automotive parts, such as transmission shafts or valves, or in cutlery, where a smooth surface finish is desired. Non-woven abrasive wheels are ideal for polishing and finishing applications, since the abrasives in a bonded or coated product may result in plowing or cutting on the surface of the workpiece.

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