

What is “Orbit Diameter”

The orbit diameter of a sander is how far from the centerline that the pad rotates. This is also called the “eccentric” of the sander. There are many orbit diameters, but the two most common are 3/32-inch and 3/16-inch. Generally speaking, smaller orbit diameters result in smoother finishes, but less aggressive cutting; while larger orbit diameters result in more aggressive sanding with less smooth results.

Reducing Scratches and Swirls

The design of a sander goes a long way toward reducing the sanding marks it leaves behind. Some sanders leave more scratches because they are designed to be more aggressive, and this can be good, but other sanders leave more scratches simply because they don’t provide smooth action in their components. The best of sanders will be both aggressive in their material removal, yet still provide a smooth finish.

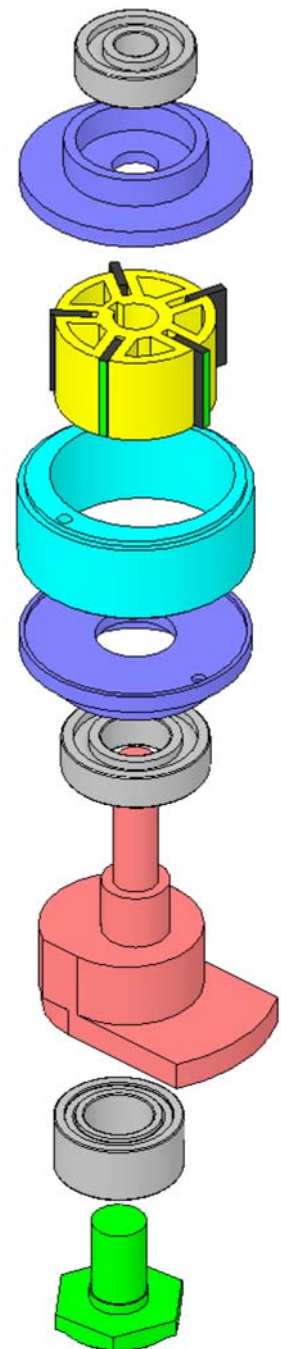
The more random the pattern, the less noticeable the scratches will be. As a result, anything that hinders the random motion of the pad’s rotation will increase the amount of visible scratches. For this reason, you’ll never find a “pad brake” on a pneumatic sander. Not only are they not needed, but they reduce the randomness of the sanding pad motion, and therefore, increase the swirl marks. If your sander pad is not visibly spinning (free-wheeling) while you are sanding, then you are not getting the full dual-action from the sander!

Electric Versus Pneumatic

The primary reason why a good quality pneumatic sander will outperform its electric sander counterpart is the quality of the drivetrain. The majority of the cost associated with manufacturing an electric sander is in the motor itself, such as the copper and laminated rotor, with less money left over for the drivetrain. A pneumatic sander has a very simple motor, and therefore, more of the cost of the sander can be associated with the drivetrain components.

For example, a typical electric sander has an aluminum eccentric flywheel and a simple 1/4-inch bearing between the flywheel and the sanding pad, and all of this is held together with a single screw. On the other hand, the Dynabrade sander has a machined steel flywheel (balancer) that is actually contiguous with the rotor shaft of the motor (this is the red-colored piece in the drawing to the right). Because this eccentric shaft is a single piece with the motor shaft, there is virtually no chance for runout or wobble in the output of the sander pad.

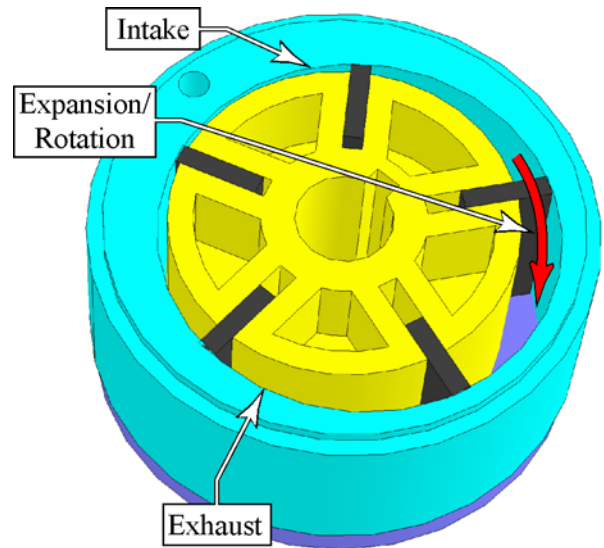
Additionally, instead of a 1/4-inch thick bearing pressed into an aluminum bore, the Dynabrade sander uses a 5/8-inch thick bearing pressed into the machined steel bore of the eccentric balancer. The result is a dead-straight drivetrain.



Size Matters

The Dynabrade is small—Really small! At only 3 5/8 inches tall, it is almost half the size of most electric sanders, yet has more horsepower. At 1/4 hp, only a couple of the larger, heavier sanders can compare. The reason why it is small with a lot of power, is because of the pneumatic motor versus the heavy electric. Your 300 pound compressor sitting in the corner is providing the power "remotely".

A rotary vane motor is kind of like the Wankel rotary engine made most famous in the Mazda RX7 sports car. Even though the engine types are slightly different, the primary concept is an expanding cylinder space as the rotor turns. Air enters the chamber where the rotor is closest to the cylinder wall, and pushes against the vanes as it tries to expand. On the exhaust side of the cylinder, the decreasing size of the chamber pushes the compressed gas out of the cylinder.



Fatigue

It doesn't take very long while sanding for your whole body to wear down and grow fatigued. It isn't just a simple matter of how hard you are working, but also the strain you are putting on your whole body while you sand. Part of this is exertion, but a significant portion is due to vibration and comfort. Because the Dynabrade sander is lighter than other sanders, the vibration is greatly reduced as the eccentric balancer rotates.

Moreover, because the sander is not as tall as an electric sander, it takes less energy to control the sander. If you are male, you probably haven't spent much time walking around in high-heel shoes, but your wife could certainly attest that it is far easier walking around in flat tennis shoes than it is in high heels. Likewise, with your hands closer to the workpiece, it takes less effort to maintain control of the sander.

Putting Your Money Where Your Scratches Are

A few years ago when I was a magazine editor doing product reviews, I performed a scientific comparison of sander performance based on both sanding aggressiveness and the quality of the final finish. I built a motorized sanding rig that simulated the operator's movement of the sander across a test piece of maple. I weighed each test piece before and after the testing to determine how aggressive the sander operated. I also used a dissecting microscope to analyze and count the number of scratches each sander left behind. (I used to be a certified microscopist for counting asbestos fibers, and utilized the same statistical techniques for evaluating the sander scratch patterns.)

What some woodworkers might find surprising is that some of the best known and popular sanders on the market actually scored the lowest in terms of both their aggressiveness and their scratch quality. As a matter of fact, contrary to reason, some of the sanders that had the worst scratch pattern also had the lowest sanding rate. But by a wide margin, the Dynabrade sander scored highest in both aggressiveness and lowest scratch count. This means it takes less time for you sand a project, and less chance that you will discover sanding swirls when you begin to apply your finish!

Conclusions

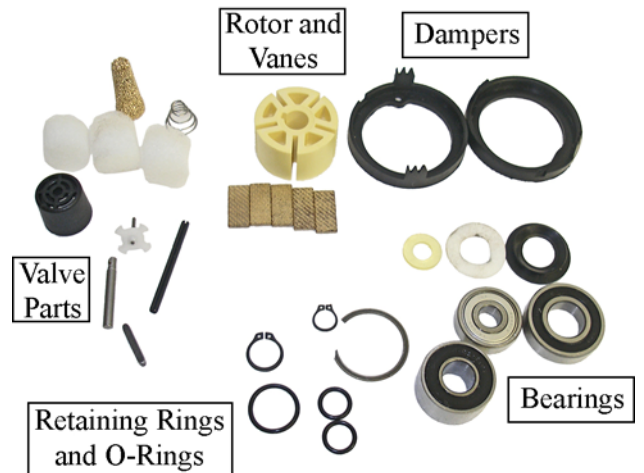
A pneumatic sander is not for everybody, but as a woodworker grows his skills and repository of tools, stepping up from an electric sander to a pneumatic sander will be one of the most significant leaps he can make moving forward. When you are ready to make this leap, don't make the common mistake of buying a cheap hardware store class pneumatic sander and expect it to perform at the level you demand. The Dynabrade sander is considered to be the best sander on the market by most professionals, and can be found in many professional shops that run the full range from woodworking to automotive body work. Once you try a pneumatic sander, you will wonder how you ever got by without one in the past.

<p>Sidebar: Are Pad Brakes Really Any Good?</p> <p>As a supplement to my analysis of sander scratch patterns several years ago, I wanted to verify my assumptions that non-randomness in the pad rotation increased the scratch pattern of the sander. I took several electric sanders that had pad brakes and repeated my testing with the pad brakes removed or disabled. The results were absolutely conclusive without exception. Every single electric sander performed better when the pad brake was removed.</p> <p>Moreover, the Porter Cable sander has, without doubt, the most effective pad brake of any electric sander I examined. As a result, it also had the most dramatic improvement of scratch patterns when the brake (a plastic o-ring) was removed.</p>	<i>The results listed below are in scratches per square inch (s/in²):</i>	
	Porter Cable 332	
	w/brake:	2693 s/in ²
	w/o brake:	537 s/in ²
	DeWalt 421	
	w/brake:	1571 s/in ²
	w/o brake:	500 s/in ²
	Festo ET2E	
	w/brake:	713 s/in ²
	w/o brake:	486 s/in ²
	Metabo XSE 425	
	w/brake:	181 s/in ²
	w/o brake:	65 s/in ²
	Makita BO5010 (pad appeared to be slightly bent)	
w/brake:	503 s/in ²	
w/o brake:	741 s/in ²	

Rebuilding My Dynabrade

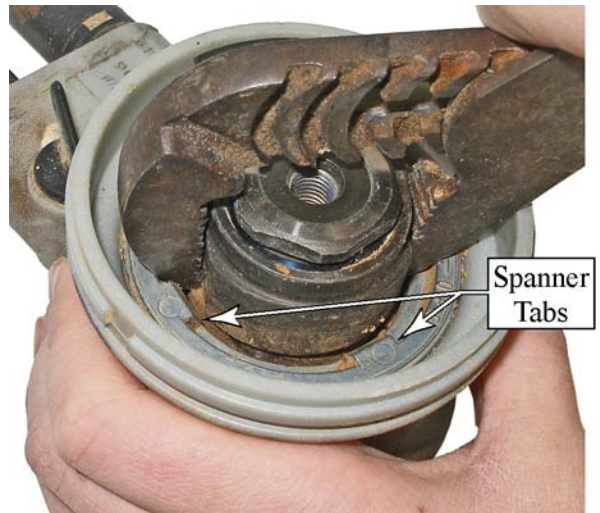
One of the main reasons for updating this article is because I recently rebuilt one of my oldest sanders, and I wanted to relate this experience to others. For most sanders, when they reach their end of life, they are done and just scrap. With the Dynabrade, the design is so robust that the sander can be rebuilt and brought back to new condition indefinitely.

I picked up a complete rebuild kit from <http://www.phillytools.com/> and was surprised to discover that the kit includes virtually every component in a sander except for the cylinder and main housing. I was expecting just the rotor, vanes, and bearings; so it was a bit of a shock to open the bag of parts and find everything shown to the right.



You should be able to rebuild a sander in less than an hour using a few common tools around the shop. The first step is to remove the sanding pad. Your Dynabrade sander should have come with a factory supplied pad wrench, and you simply unscrew the pad from the eccentric balancer.

The most complicated part of disassembling the sander is removing the spanner nut holding the motor into the housing. I found that a standard Arc Joint pliers (shown below) works very well for removing the spanner nut. I open the pliers so that the outside of the jaws are engaging two of the four tabs on the inside of the spanner nut, and then I just unscrew the nut (counterclockwise).



With the nut loosened, I rotate the nut vertical, which will pull up on the motor cylinder and loosen it from the housing. I then just lift the cylinder out of the housing.



Disassembling the Motor

The first step in disassembling the motor is to drive out the motor shaft from the cylinder caps. The bearings are press-fit into the caps and onto the shaft, but not so tight that you will need an arbor press to complete this.

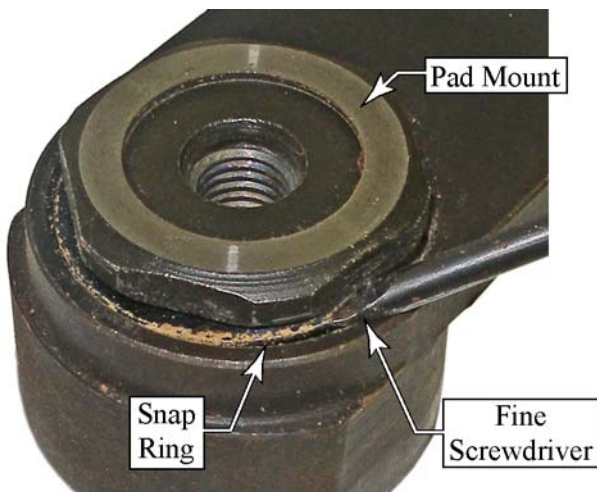
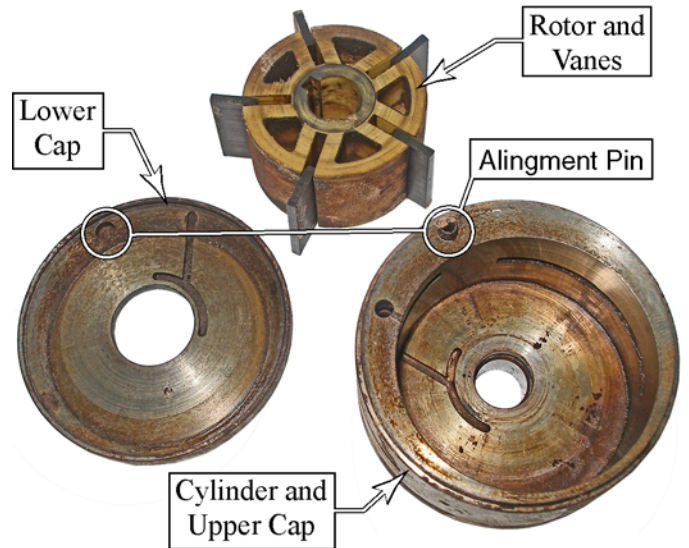
Place the eccentric balancer loosely between the jaws of a bench vise and the lower cylinder cap resting on top of the jaws. Use a punch to drive the motor shaft out of the upper bearing. The lower bearing will most likely remain on the motor shaft and slide out of the lower cylinder cap.



Turn the upper cylinder cap over, and drive the upper bearing out of the cap in a similar fashion. I found that a small socket would fit through the cylinder cap, but not the bearing, so this worked well for driving the bearing out of the cap.

Remove the upper and lower cylinder caps from the cylinder, and remove the rotor and vanes. Make sure to fully clean the cylinder, caps, and all of the air channels. If necessary, use a plastic scotch pad to polish up the steel surfaces.

To remove the lower bearing from the motor shaft, I found that driving a large screwdriver between the bearing and the eccentric hub was sufficient to free the bearing. Make sure you keep working the bearing loose from all sides to prevent the bearing from getting skewed on the shaft.

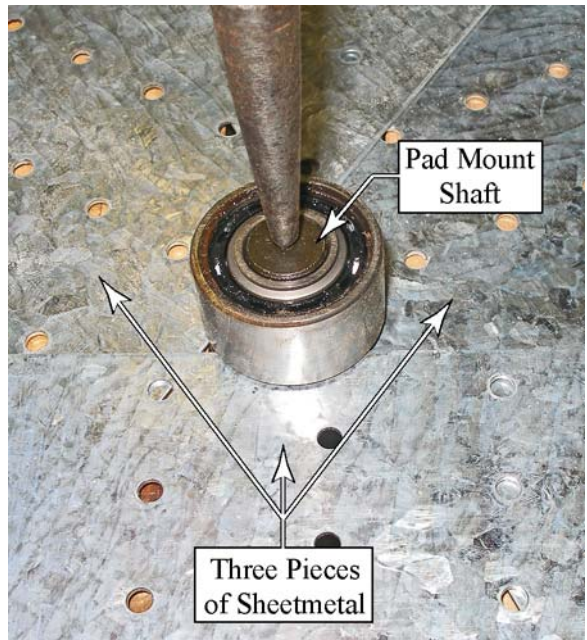


The main eccentric bearing is held into the eccentric balancer with a snap ring inside a groove in the bearing pocket. Locate the gap in the snap ring, and pry the ring out of the groove (toward the center of the shaft) using one or two jeweler's screwdrivers--working your way around the ring until it is free.

The eccentric bearing is only loosely pressed into the eccentric balancer, so you can gently pry it (and the pad mount) out of the bearing pocket.



The eccentric bearing is pressed fairly tightly to the pad mount shaft. To support the bearing while I drove the shaft out, I placed 3 pieces of heavy sheetmetal in a triangle between the bearing and the flange of the pad mount, with the pad mount between the jaws of my bench vise. Then I drove the pad mount out of the bearing with a punch.



Disassembling the Air System

Just like an automobile engine, the less restriction you have in getting the air into and out of the motor, the more efficient and powerful it will operate. The inlet contains a valve, and the exhaust contains a brass filter and silencer pads.



Remove the air lever by sliding the roll pin out of the housing. Unscrew the inlet bushing from the housing, and remove the spring, tip valve, and seal. Then, using a retaining ring spreader, remove the retaining ring from the top of the valve plunger, and slide the speed regulator out the bottom.

Remove the muffler cap by rotating it slightly (to free it from the locking tabs) and then pull it off. The muffler body has a 1/2-inch hex socket. I don't have an allen wrench this large, so I used the hex head of a bolt to unscrew the muffler body. Remove the brass cone muffler from the muffler body.



Reassembly Notes

- Make sure to refer to your exploded view parts list for component placement.
- Insert the needle of the tip valve through the hole in the plunger.
- When assembling the rotor and vanes, apply a small amount of Air Lube oil to the vanes.
- Don't forget the key between the rotor and motor shaft.
- When pressing bearings into their various pockets, use the associated shaft (when feasible) to keep the bearings straight as you press them in.
- Before pressing the main eccentric bearing onto the pad mount shaft, make sure you install the spring washer convex-side facing the pad, followed by the dust pad and bearing.
- Reinstalling the snap ring on the eccentric bearing can be tricky, and it may take a couple of tries to get it installed. Place the balancer in a vice to hold it firm, and start by getting one end of the ring into the groove. Using a couple of jeweler's screw drivers, work your way around the ring and press it down onto the spring washer and it will snap into the groove.
- If you have excessive oil in the motor from your assembly, you may want to run the sander for a few minutes with a rag over the exhaust port, but without the muffler assembly installed. The oil will be captured by the rag without fowling your exhaust components.
- When inserting the assembled motor into the sander housing, take care not to wrinkle the motor damper rings.

