

GRIND A BLADE THE RJ MARTIN WAY

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Grind a Blade the R.J. Martin Way

THE AUTHOR INSTRUCTS ON FLAT- AND DOUBLE-HOLLOW-GRINDING KNIFE BLADES

BY R.J. MARTIN

PHOTOS BY JIM COOPER



R.J. Martin's Rampage fixed blade features a radical grind. The popularity of this grind has led to two successful folder designs, and the author plans to make a longer version of the fixed blade in the near future. It just goes to show what can happen when you push the envelope in blade grinding.

It has been 30 years since I first picked up a bar of steel and applied it to a moving abrasive belt in hopes of ending up with something that resembled a knife blade. I don't remember that first knife, but I remember the feeling of fascination and satisfaction that accompanied the process of grinding the blade.

The magical process of transforming a rectangular bar of steel into an edged tool by grinding away what doesn't belong—that is the essence of knife making.

When I was a high school kid in the 1970's, I started making knives. Back then, the field of knife making was still in its infancy. There were only a handful of knifemakers, none of whom lived near me. If there had been some, it wouldn't have mattered much because I couldn't drive yet! So, the possibility of visiting a knifemaker and learning by watching or by instruction was not possible for me.

Fortunately, there were books and I read every one I could find. I studied the pictures—they were most helpful, as the actual process of grinding is not an easy thing to describe. I am indebted to David Boye and Robert W. Loveless because these two men penned the words and provided the pictures for the book "How to Make Knives" that started me on my way.

I hope that in the following paragraphs I can provide for you, the reader, as much insight into the process of blade grinding as these talented individuals did for me. I am privileged to have Jim Cooper behind the camera lens in this effort, and I am sure that his talents will greatly help to clarify the meaning of my words.

EQUIPMENT

If you're going to grind blades, you've got to have some sort of grinder! If you plan to grind dozens or hundreds of blades and make a living at it, you need a well thought-out piece of machinery capable of performing all the tasks required quickly, accurately and with a minimum of operator stress. In my shop, that machine is a Bader BM2 belt sander. Actually, I employ four BM2's and the larger Space Saver machine that takes a longer belt and allows me to sit down while I grind.

You don't need five machines; one will do it all if you equip it with the needed accessories. I'll point out the accessories as they are used in the grinding of the working blade for this book chapter. I should add that there are several brands of belt grinders available and each has its loyal following among knifemakers. I have never considered buying another brand, primarily because I haven't found any grinding task that I could not accomplish easily with my Bader, and it seems to offer the best value.

The folks at Bader (Dan, Doug, Carrie and Paul) are incredible people who have assisted my career greatly over the past 20 years and have earned my loyalty. I will be using the BM2 to profile, hollow grind and taper a tang. I can also flat grind with a Bader, but I prefer to use a Sears 6 × 48 for flat grinding.

SAFETY

I'd be remiss if I didn't mention the need for eye protection. The glasses I wear (although not stylish!) are prescription safety glasses of the best quality available. I have an industrial dust collection system in my shop, so I can grind without a respirator, but without such a system, a good respirator should be worn. If not a full face respirator, a good welding fume respirator that covers the nose and mouth is advised.

You'll also want a fire extinguisher close at hand. Grinding produces a considerable amount of small, hot chips. A bucket of clean water for dipping your work into is also essential. You'll notice in the accompanying photos that I don't wear gloves. Many knifemakers do, but I feel safer without them, and I have a much better feel for what I am doing when working barehanded.

A coarse belt snagging my glove and jamming my fingers between the work rest and a moving belt is not my idea of fun. If you choose to grind as I do, you'll probably burn your fingers a few times in the beginning. After a while, your fingers will toughen up and your hands will become much more durable. In the meantime, dunk your blade after every pass, and remember the saying "It feels good when the pain stops!"

ATTITUDE

Grinding blades is not easy. You can't actually see what is happening between

the blade and the belt while you're grinding. You have to see it in your mind. That's right—blade grinding is all about visualization! You feel each pass, and then you look at the grind and see what happened. This visualization is the feedback.

Eventually (and it may take months or years), your mind will become so connected to the feelings in your hands and body that you will know precisely what is happening to your blade as you're grinding. You will develop muscle memory, and through experience, you will know exactly how to manipulate the blade to change or correct the appearance of the grind, whether moving the belt up the blade, correcting the plunge line or thinning out the edge.

This takes time, so, don't be frustrated if your first efforts are not successful. Experience is the best teacher, but there are some things you can do to help speed up the process. The first is to concentrate. You have to immerse your mind in the process at hand and pay attention. Listen to your grinder! It is talking to you!

Second, maintain a positive attitude. You have to convince yourself that when you step up to your grinder, good things are going to happen. Visualize the finished grind in your mind. If you can't see it before you start, it's not going to happen! Third, don't get too hung up on achieving the precise grind line you envision. Instead, work on achieving symmetry and flow. If the finished grind doesn't have exactly the sweep you wanted, no one but you is going to know.

But, other folks will know if the grind line on one side of the blade does not match the grind on the other. I hear from new knifemakers all the time who say they got one side of their blade ground perfectly, but ruined the blade because the second side came out differently and they went too far trying to even up the grind lines. The flaw is in their approach; they should have focused on grinding a blade where both sides are symmetric, even if the appearance of the grind line isn't exactly what they envisioned.



R.J. Martin's Kwaiken model showcases a chisel-ground blade. A chisel grind is a one-sided grind that

eliminates the problem of maintaining symmetry in blade grinding.



Using a 10-inch length of A-2 tool steel, the author scribes the blade outline onto a blade blank using a template made from scrap G-10 and a carbide-tipped scriber.

SCOPE

I will be performing four specific grinding operations: Profiling, hollow grinding, flat grinding and tang tapering. If you can master these four operations, you can grind virtually any knife blade. Grinding a blade's profile is the starting point for anyone practicing the stock-removal method of knifemaking.

Hollow grinds and flat grinds are the most common blade grinds used on knives. If you know how to flat grind, you can achieve a convex grind by finishing your grind on a slack belt. Knowing how to taper a tang will allow you to dress up any full-tang fixed blade knife you want to make.

ADVICE FOR THE BEGINNER

There are a few things you can do to help yourself be successful as you get started:

1. Use simple carbon steel, like grade O-1 tool steel. Spend the extra pennies and get it precision ground. This will help you start with a flat, clean bar of steel that is a constant thickness;

2. Start with a simple design. A nice, 3-to-4-inch-long blade hunting knife pattern is fine. The grind techniques I demonstrate for my Manta Ray will work nicely on such a blade. Just omit the top grind until you're comfortable trying it;

3. Work in batches. It is much better to perform the same operation on four or five blade blanks in succession than it is to grind one blank from start to finish. Remember, muscle memory is all about repetitive actions. You'll find that, by the third blade, you're body will be getting into the swing of

grinding;

4. Light your grinder well. Light is key to seeing what is happening as you grind; and

5. Wear boots, if you can, to give yourself a solid, balanced base.



The author uses a 10-inch contact wheel to remove the excess steel, starting near the tip-end of the primary bevel. He works from left to right, using his left thumb to push the steel against the belt, and his right hand to steer the work so that the scribe line is kept parallel to the face of the contact wheel.



It's a simple matter of working repeatedly from the handle to the tip, pressing lightly on the belt and keeping the blade blank moving until you see the scribe line disappear. Then, move on to the tip bevel.



The author rounds both corners of the butt end of the handle.

PROFILING A CHISEL-GROUND BLADE

I'm starting with a chisel grind for a few reasons. The chisel grind is a one-sided grind, which eliminates the problem of symmetry. This is a big help for the beginner, allowing him or her to concentrate on one bevel. The majority of my Japanese-style knives are chisel ground.

There is a choice of edge styles that comes with a chisel grind. The "standard edge" exhibits a blade that is ground down to, say, .02 inch, and a small, secondary bevel continues from that point, making up the cutting edge. The bevel of a "zero grind," on the other hand, is reduced to "zero thickness," and thus, becomes the cutting edge. While the "zero grind" is more complicated to grind, because the entire bevel must taper precisely to nothing along the entire cutting edge, it is the grind I prefer because of its cutting ability. It is the grind I will demonstrate.

Using a 10-inch length of A-2 tool steel, 1 1/4 inches wide by 1/4-inch thick, I scribe the blade outline onto a blade blank using a template made from scrap G-10 and a carbide-tipped scriber.

The shape of the knife fits nicely on this stock size, and there is not much material to remove to achieve the finished profile. Keep this idea in mind as you design a knife. The closer you match your knife's shape to your stock size, the less work (and waste) you'll have in profiling.



The intended blade grind is now fully defined on the blade blank.

I have one machine set up with the work rest at the proper height for profiling so that the center of the stock lines up with the center of the wheel. You'll need to take a minute to check your results as you start profiling to be sure that your work rest is at the proper height. The profile of your knife should be square with the sides of your blade blank.

Using a 10-inch contact wheel and a used, 60-grit 3M 967 belt, I remove the excess material, starting near the tip-end of the primary bevel where I have the most material to remove. I work from left to right, using my left

thumb to push the steel against the belt and my right hand to steer the work so that the scribed line is kept parallel to the face of the contact wheel. Note in the accompanying photo how my left index finger is bracing against the bar that supports the work rest.

As I profile, I remove steel until I am about .04 inch away from the scribed line. The portion of the blade blank that will become the primary cutting edge now has the shape I want but is uniformly oversized. I shift my attention to the tip, and remove material until I am about .04 inch off the scribed line.

From here, it's simply a matter of working repeatedly from the handle to the tip, pressing lightly and keeping the blank moving until I see that scribed line disappear. Then, I move on to the tip bevel.

At this point, I change over to a new, 220-grit belt and go over the edge profile. I work lightly to remove the 60-grit scratches and even up the profile. I shift my attention to the butt end of the handle and round both corners smoothly. The chisel-ground blade of my "Kwaiken" model is now profiled.

Profiling is not a difficult task compared to grinding bevels. However, it does demonstrate some key concepts that apply to all grinding:

1. Start your grinding at the area that has the most material to be removed'
2. Establish an even line as you approach your final result;
3. Work "downhill" whenever possible so that you are moving the blade blank towards the grinder as the pass progresses; and
4. Keep your work moving, using less pressure as you finish.



Note how the author supports the back of the blade on the edge of the work rest and applies pressure with his right thumb.



The author adjusts the belt tracking so that about 1/8-inch of the belt hangs over the left side of the wheel.

GRINDING THE BEVEL OF THE KWAIKEN MODEL

I coat the blade with layout fluid, allowing it to dry before scribing my upper grind line .90 inch from the edge using a digital caliper. I also add a scribe line that defines the start of the plunge area, 5 1/4 inches from the tip of the blade blank. Then, I freehand scribe a line that connects the plunge to the top grind line, just for reference. The intended blade grind is now fully defined on the blade blank.

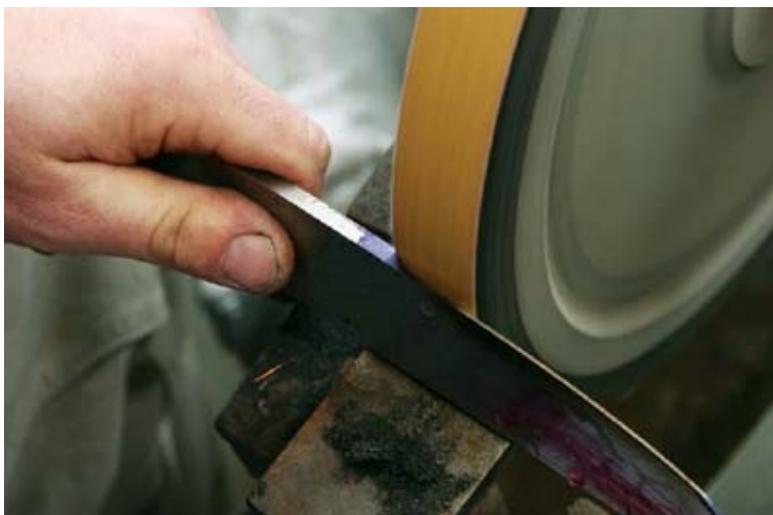
Using the same, worn 60-grit belt I profiled with, I rough in the tip grind. This grind will be completed after heat treat, using a slack belt to produce the convex bevel that adds both strength and style to the finished knife.

For now, I just want to get most of the material off, so, I leave the tip about 0.05-inch thick, with the grind running about one-third of the way up the blank. Note in the accompanying photo how I support the back of the blade on the edge of the work rest and apply pressure with my right thumb.

Whenever you put the tip of a knife against the belt in this way, you want to brace the work well, and for safety purposes, ease it into the belt. After a pass or two, the tip bevel looks like the one illustrated in the accompanying photo. Cool the tip off in your water bucket before proceeding.



As the author pulls the blade from right to left, he needs the blank to move freely across the face of the belt. To achieve this, his left hand must be slightly forward of his right hand. Otherwise the belt will dig into the steel and hang up, keeping him from completing the pass.



There is always a bit more pressure on the left side of the belt than the right.

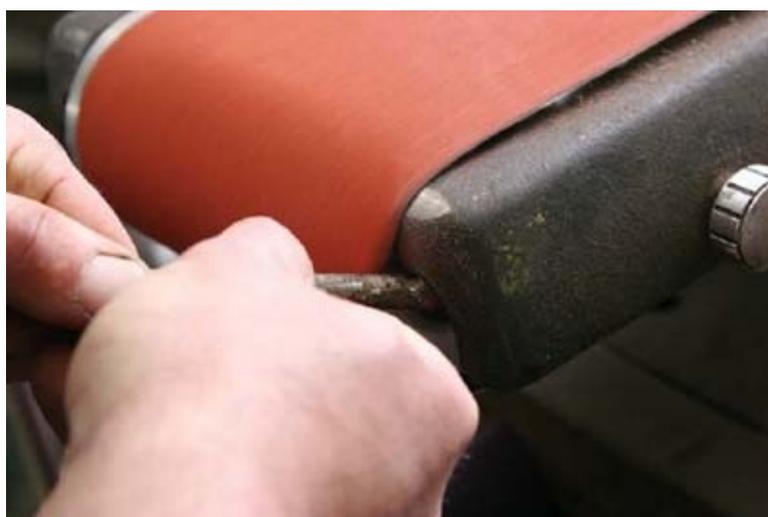
With a new, 60-grit belt in place on the 10-inch wheel, it's time to rough in the primary bevel. Remember, I plan to finish the bevel on the 6 × 48 flat sander, so this effort is intended to set up the bevel for finishing. I need to leave enough meat on the blade blank so that all the hollow grind marks will clean up when I flat grind.

Before I start grinding, I take a minute to break down the stiff, left-hand edge of the belt using a steel rod, and adjust the belt tracking so that about 1/8-inch of belt hangs over the left side of the wheel. This will help ensure a smooth, gouge-free plunge area.

Beginning about 1/8-inch forward of the scribed line that defines the start of the plunge, I begin the rough grind. My left hand firmly grips the blank and is responsible for setting the angle that the edge is presented to the belt. My right hand grasps the tip.



The grind line is being pushed up towards the scribed line, and the edge is still plenty thick.



The author uses a piece of round bar to break the edge of the belt down and adjust the belt tracking so that about 1/4-inch of the belt hangs over the platen.



More contact area means that greater force must be applied to maintain the edge pressure.

This is a right-to-left pass, so the blade is pressed into the left side of the wheel face. The right side of the belt is barely touching the steel. As I pull the blade from right to left, I need the blank to move freely across the face of the belt.

To achieve this free movement, the left hand must be slightly forward of the right hand. Otherwise, the belt will dig into the steel and hang up, keeping me from completing the pass.

As I start the third pass, I can (hopefully) see the light area at the right side of the wheel, indicating the gap that exists between the blank and the wheel. As the pass is started, only the left side of the belt contacts the work.

Immediately, as I start to move the blank from right to left, my right hand moves the tip forward so that the blank is pressing across the entire face of the belt. There is always a bit more pressure on the left side of the belt than the right, but not much.



Illustrated is how the plunge area is worked using the rolled edge of the belt.



The edge is approximately .02-inch thick, and the grind is looking good.

THE FINESSE OF GRINDING

If you're getting the idea that there is a lot of finesse involved in grinding, you're right. There is. You can spend a lifetime discovering the techniques that work for you as your skills progress. But, to get you started on the right path, there are two relationships that require an explanation.

The first is the positional relationship between the left and right hands. A good analogy is a child's seesaw. Imagine a seesaw tipped on its side. The blade blank represents the board of the seesaw. Your left hand holds one end of the board and your right hand holds the other.

The area of contact between the blade and the abrasive belt is the fulcrum of the seesaw. Now, if your left hand is forward of your right as you grind (like when you make a right-hand turn on a bicycle) you're in position to make a pass from where the blade moves from right to left. This is how all passes on the right side of a blade are made. If you are grinding the other side of the blank, the reverse applies. The right hand is forward of the left and the blade is moved from left to right.

The second relationship is that of the blade blank to the wheel, in a vertical direction. When grinding a blade edge up, you are grinding the edge towards a fixed goal—either a scribed line or the opposite edge of the blank in the case of the chisel-ground Kwaiken.

You can see this goal all the time as you grind. But, you are also grinding towards another goal, which is the top of the grind line. You can't ever see this directly as you grind, as it is always hiding behind the blade. As I said earlier, the only way to check your progress towards this goal is to look at the blade after the pass is made.

So, you must pay attention to the edge thickness as you grind, and pay attention to the grind height after each grinding pass. The desired result, of course, is to have your edge at the proper thickness just as your grind line reaches the desired height and appearance. Eventually, you will learn to feel

your way, and you will know how you have changed your grind line with each pass before you even look at it.

My approach to this aspect of grinding is purely pragmatic. I begin by tipping the edge of the knife into the belt, working only to reduce stock at the knife's edge for the first few passes. I'm only concerned about working towards the final edge thickness, and my goal is to obtain a nice, uniform (but thick) edge.

Then, I can make subsequent passes, applying torque to the blank, twisting the back of the knife into the belt, so that I push the grind line up the blank. As you can see in the accompanying photo, this is where I am with the chisel-ground blade blank. The grind line is being pushed up towards the scribed line, and the edge is still plenty thick.

It is now time to switch over to the 6 × 48 flat sander using a new, 60-grit 3M 977 belt. My machine has a reversing switch on it, so, I can run it in either direction. For a right-hand chisel grind, I want the belt coming towards the knife's edge, moving away from me. Once again, I use a piece of round bar to break the edge of the belt down and adjust the belt tracking so that about 1/4-inch of the belt hangs over the platen.

At this point, I take a few passes to clean up the hollow-grind scratches and create a new, flat surface. I apply a great deal of pressure here with the thumbs of both my right and left hands.



Because the edge of the Kwaiken knife model is gently curved, it is necessary to lift the handle of the blade as the grind progresses toward the tip in order to keep the bevel in contact with the belt.



The primary blade bevel is uniform and disappears right at the edge of the knife.



A few extra passes are required to bring the edge to “zero thickness” in the plunge area.

THE FEARED FLAT GRIND

Flat grinding is considerably harder on the operator than hollow grinding. The belt is supported by a steel platen, which offers no cushioning like the rubber-coated contact wheel. So, there is a loss of feel to be dealt with in flat grinding. Also, the contact area between blade and belt is greater, meaning that you are putting a lot less pressure on the belt with the same force applied to the blank. (Pressure = Force/Area)

More contact area means that greater force must be applied to maintain the same pressure. So, in this portion of the grind, just focus on managing the edge thickness and achieving a smooth, flowing top grind that approaches your scribed line.

In the accompanying photo, you can see how the plunge area is worked using the rolled edge of the belt. Even for experienced makers, the plunge area is difficult to grind. If your early results don't look as good as mine, don't worry. Just keep practicing. After three or four passes, I have established the proper pre-heat-treat geometry. The edge is approximately .02-inch thick, and the grind line is looking good. The tip will be shaped further after heat treatment.

After heat treatment, it's time to regrind the Kwaiken blade. From this point on, I must remember that this is a heat treated and tempered blank and I can ruin it in an instant if I overheat it. Even though I grind with bare hands, I'm far enough away from the edge of the knife, where the heat will build first. I force myself to dunk the blade after every grinding pass.

I regrind the blade on a new, 120-grit 3M 967 belt. This is a nice belt for flat platen grinding because 3M removes the abrasive in the splice area, making for a smoother grinding experience. Being careful to grind evenly, I take the edge down until it becomes extremely thin. This pushes the grind line up to its final height. The only way to master the zero grind is to practice!



Note how the author uses the middle finger of his left hand to trap the back end of the blade, preventing it from being pulled from under his fingers by the moving belt.



After three or four light passes on a 240-grit belt, the 120-grit scratches are gone and the blade starts to look good.



The author creates a secondary grind along the spine of the blade. He uses a 10-inch wheel and holds the spine of the blade at a 45-degree angle to the wheel, being careful to grind on the portion of the belt that is