Saw Sharpening Basics

Equipment

Vise - Whether made of wood, cast iron, or steel, the first and foremost characteristic to look for in a saw vise is rigidity. The bigger the teeth you are filing, the more important this becomes.

When searching for an old cast iron vise, look for a design that is not highly cantilevered; if the vise is one that pivots, that joint should lock solidly. While a saw vise that tilts is useful for filing sloped gullets, that usefulness comes at the cost of rigidity.

Recommended models: Disston No. D3 (sometimes called 3D) or Wentworth No. 1 or 2. If you are only filing small teeth, or want to file sloped gullets, the Disston No. 1 or Stearns No. 33 may be acceptable.

Wood saw vises that mount directly in a bench vise are generally very rigid. If you stand while filing, they may be a little low and you may want to consider making a cantilevered version. There are numerous designs for these online, so pick a design that you like. Just make sure that it remains rigid.

To my knowledge, the only saw vise currently in production is made by Gramercy, which is by all accounts an excellent vise.

Beyond rigidity, ensure that the jaws align evenly across the entire width. Better vises have jaws that are made slightly concave so that when clamped, the saw is held evenly and securely along the entire width. Some vises have accommodations for a leather or rubber lining that further enhances the grip on the blade and diminishes vibration.

Magnification - A magnifying lens of some sort is very useful for inspecting teeth and progress in sharpening, especially as the tooth size decreases. A magnifying lamp or visor, magnifying glass, loupe, or even reading glasses are all options. I use a 10X jewelers loupe for inspection.

Light - Backlighting is very helpful when sharpening. It can be as simple as sharpening in front of a window. If you don't have that, or sharpen at night, then task lighting is called for.

Jointer - Vintage cast iron saw jointers abound. To facilitate breasting the saw blade, some of these jointers can add camber to the file (although it certainly is possible to add breasting without this feature).

I use a short length of aluminum angle in lieu of a jointer.

Jointing file - The traditional file of choice for this task is an 8" or 10" mill bastard file. While these work well, I just use old saw files.

File handle – To stave off fatigue and cramping and to prevent injury, always use a handle on the tang of the file. In addition to the above benefits, a handle can be a great aid in maintaining consistent registration of the file to your hand, enhancing the consistency of your filing.

There are numerous designs available on the new market. Old cast iron models are also readily available. In the user made realm, dowel rods, golf balls, and even corn cobs have been successfully used as handles.

Saw files - The file is perhaps the most important part of sharpening. Look for even teeth, sharp and consistent corners, and straightness throughout the body. Unfortunately, visual inspection cannot ascertain the more important qualities of sharpness and durability; these are proved only by use. While many files will do an acceptable job of touching teeth, filing in new ones is a much more demanding task. Some of the better files available today are Bahco, Pferd, and Glen-Drake saw files; Glardon needle files are an excellent choice for fine teeth.

Sizing the file to the teeth is also important. The chart below summarizes my guidelines for selecting files; others are available elsewhere.

File Size	PPI Range
7 ½" Three-square needle file	11 – 20
4" X-slim taper file	11 – 13
6" XX-slim taper file	8 – 11
6" X-slim taper file	7 – 9
7" X-slim taper file	5 ½ - 7 ½
8" Regular taper file	4 – 5
10" Regular taper file	3 - 3 ½

A more fully developed guide to choosing saw files is available at blackburntools.com/blog (search there for "concerning saw files").

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Angle guide - While not strictly required, particularly for larger teeth that are already properly formed, a filing guide of some sort is invaluable in maintaining and achieving consistent rake and fleam angles. While commercial guides are available, these guides can be as simple as a small block of wood stuck on the end of the file.

Dykem (or marker, soot, etc.) - Filing a saw places a strain on your eyes – tooth after tooth must be shaped as identically as possible, requiring intense concentration at close distances. Dykem (or some other marking agent) eases that strain, providing a stark contrast between the filed and the yet-to-be filed steel. Progress is easily monitored, and sharpness of a tooth is readily apparent – when the flat red spot at the tip of the tooth has disappeared, the tooth is sharp.

Keep the top on the bottle when not in use!

Saw sets - Setting the teeth is a vital part of sharpening, and the staggering array of saw sets made and sold over the years reflects that importance. Broadly speaking, these devices fall into one of three classifications.

Saw wrest – These resemble a wrench, with a series of small slots on one end. The proper slot is placed over a pair of teeth, then twisted to bend the teeth outward.

Hammer set – This device has an anvil and a hammer. The saw blade is placed on the anvil, directly below the hammer. When the hammer is struck, the tooth is bent out.

Pliers or pistol grip saw set – This is the most popular variety of the saw set. While nearly countless models were made over the years, there are a few that stand out:

- Millers Falls No. 214 – These are solid sets, well made and with little of the slop that plagues many other models.

- Eclipse No. 77 – While not as hefty or accurate as some of the others on this list, they do have the advantage of needing little clearance. When other sets cannot reach the teeth directly below the handle of smaller saws, this one will. Unfortunately, the angle on the anvil is closer to 20° than 15°, meaning that the tooth must be set close to the tip to avoid oversetting the saw. In recent years, Somax has reproduced this model; I greatly prefer the original versions.

- Stanley No. 42X – Widely touted by many as the greatest saw set ever made, this is an excellent set, and one that I often reach for. Because of its popularity, they command a premium on the market, even for user models. Well suited for smaller teeth, but the spring-loaded plunger that grips the blade before the hammer bends the tooth is often not strong enough to resist the forces needed to bend larger teeth.

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- Stanley No. 42 – This set is similar to the 42X, but does not have the spring-loaded plunger that grips the blade before the hammer bends the tooth. So long as the fence maintains contact with the side of the blade (not a difficult task), this makes no difference. When setting large teeth, the lack of a plunger is an advantage; this is my set of choice for teeth larger than 8 or 9 ppi.

Modifications to saw sets - I routinely modify my sets. To use a set on finer teeth, I grind the plunger to a narrower point. The second modification applies specifically to the Eclipse type sets. These sets have a round disc with a variable chamfer around the edge; this chamfer is angled at 20°, which is too steep. I flip the disc over and grind several chamfers of varying size at 15°, then grind the face of the hammer to 15° so that it matches the disc.

Dressing stone - Dressing or stoning the teeth is done by ***very lightly*** passing a stone over the sides of the teeth. This removes the burrs that are formed on the edge of the teeth during sharpening, evens out variations in the set, and can also correct drift that occurs when cutting. There is a fourth possible use, which is to reduce overly set teeth, but it is far better to set the teeth properly in the first place.

Brush - Used to clear the metal filings from the teeth and moving parts of the saw vise, preventing premature wear.

Setup and preparation

Work height – Whether you work seated or standing, the teeth should be at elbow height. This height lets you keep your forearm and wrist aligned, maximizing comfort and accuracy.

Rigidity – The bench, saw vise, and the connection between the two should all be as rigid as possible. Any movement in them will lead to vibration and chattering; this shortens file life and decreases accuracy.

Lighting - For maximum benefit, position your bench so that the light from the window reflects off of the tips of the teeth. If you are using a lamp, position it behind the saw so that the light reflects off of the tips of the teeth. If possible, eliminate or minimize other light sources to lessen distractions.

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Saw tooth geometry

An understanding of the terms and geometry used being essential to learning and understanding how to sharpen a saw, those same are briefly defined and discussed below.

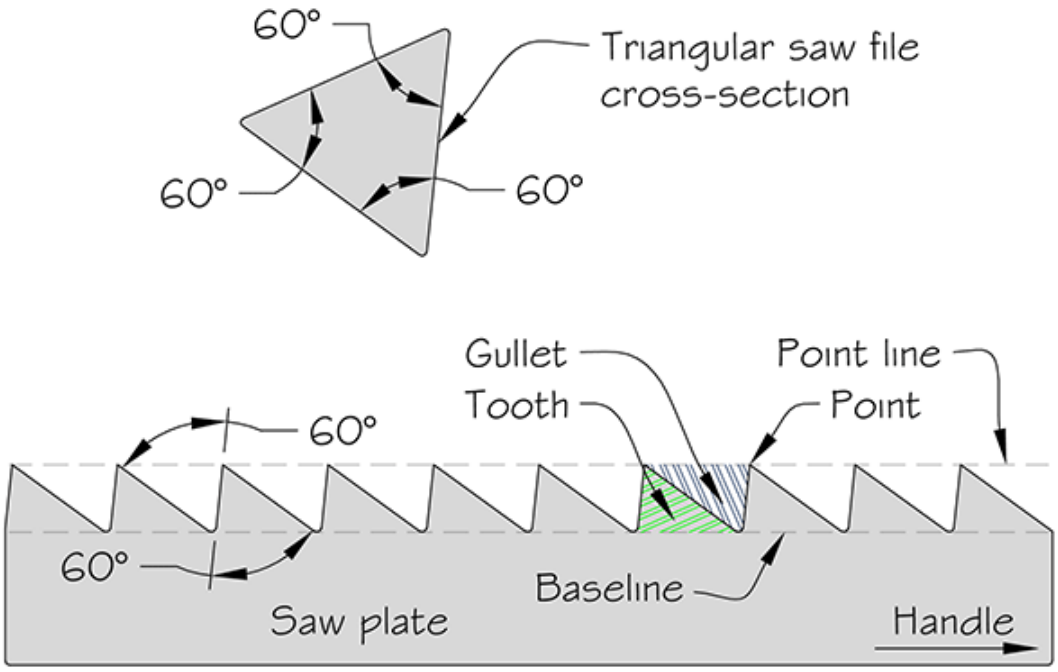

Figure 1. Basic saw tooth nomenclature.

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Broadly speaking, saws may be divided into two categories. Rip saws are meant to cut parallel with the grain of wood, while cross cut saws are used to cut across, or perpendicular, to the grain.

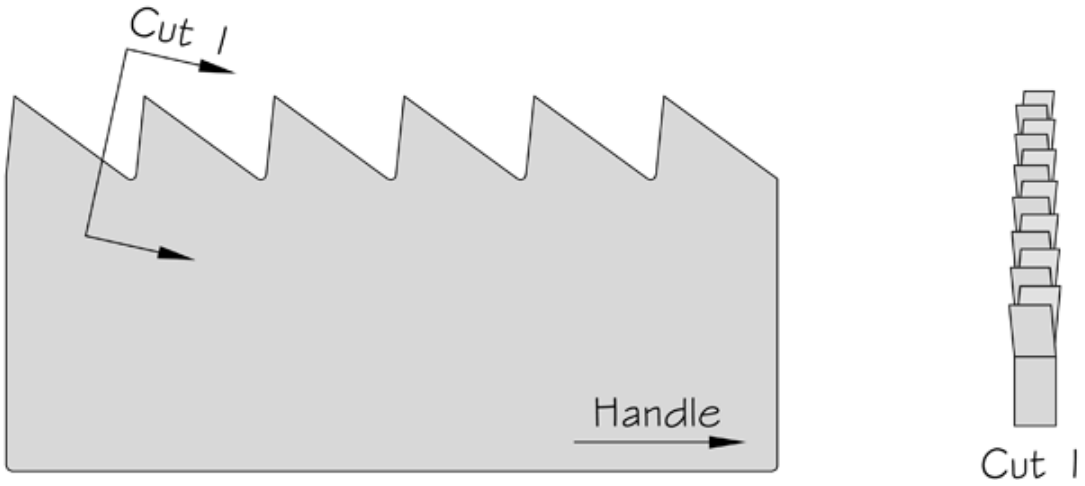

Figure 2. Rip teeth viewed from the side and the toe.

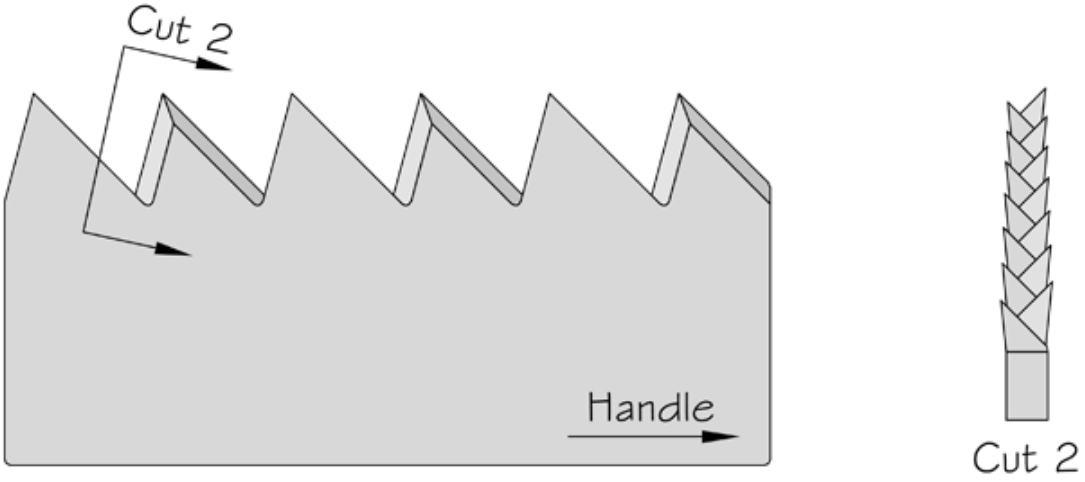

Figure 3. Cross cut teeth viewed from the side and the toe.

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Figure 4 shows the three planes or dimensions that the file can be rotated in. All angles involved in saw sharpening are defined by some combination of these three angles.

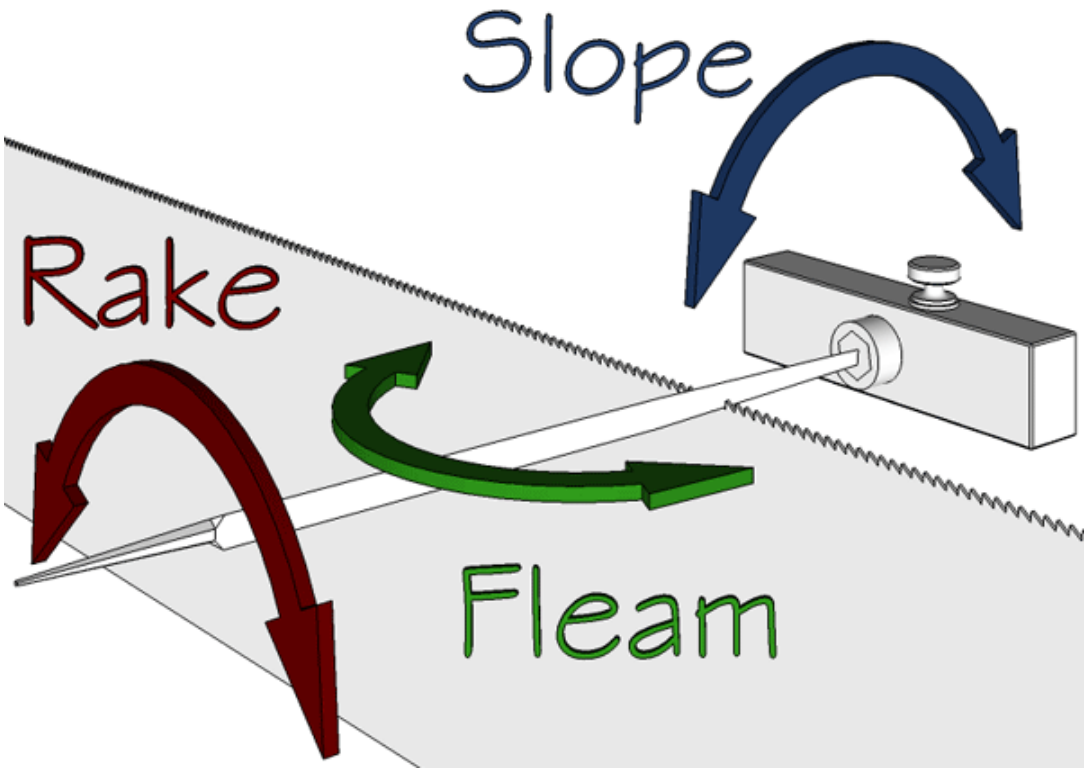

Figure 4. Rotation of file in the rake, fleam, and slope planes.

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Pitch is a measure of the number of points or teeth that fall within one inch, as measured along the point line. It is expressed as either points per inch (ppi) or teeth per inch (tpi). While most American saws were (and are) described in ppi, British saws are traditionally described in tpi. Converting between the two is simple:

ppi = tpi + 1

tpi = ppi – 1

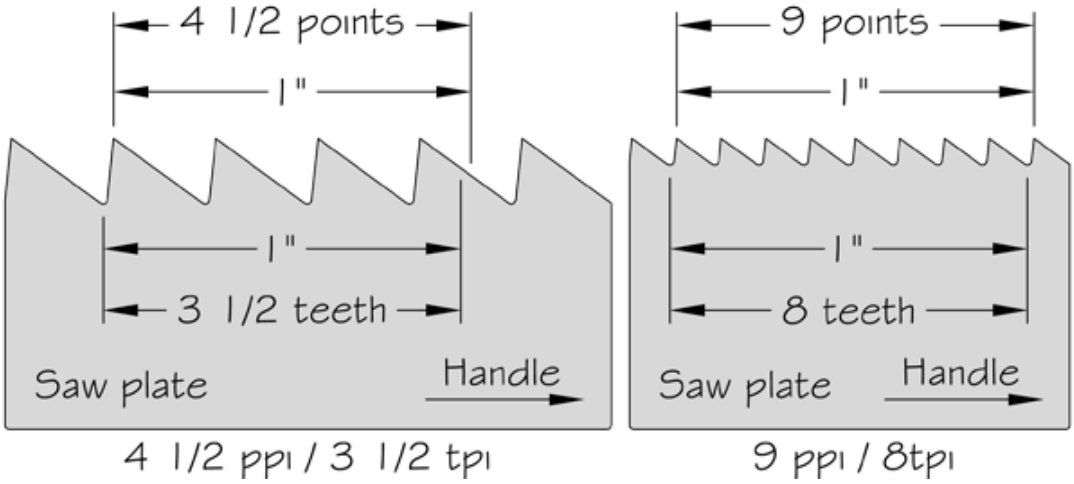

Figure 5. Measuring pitch.

Rake is the angle that the front of the tooth makes with a line drawn perpendicular to the point line, and lying in the plane of the saw plate (Figure 6). It is created by rotating the file about its longitudinal axis (as shown in Figure 4). The main role that rake plays is controlling the aggressiveness of the saw. All other things equal, a saw will cut more aggressively as its rake is decreased.

While most saws are filed with a uniform rake along the length of the blade, some are filed with progressive rake, which is accomplished in one of two ways. The first is to simply file or cut the first few inches at the toe of the saw with greater (more relaxed) rake. The second is to gradually decrease the rake over the entire length of the saw. The goal of either filing method is the same: make the saw easier to start while taking advantage of the momentum and power present towards the middle and end of the stroke.

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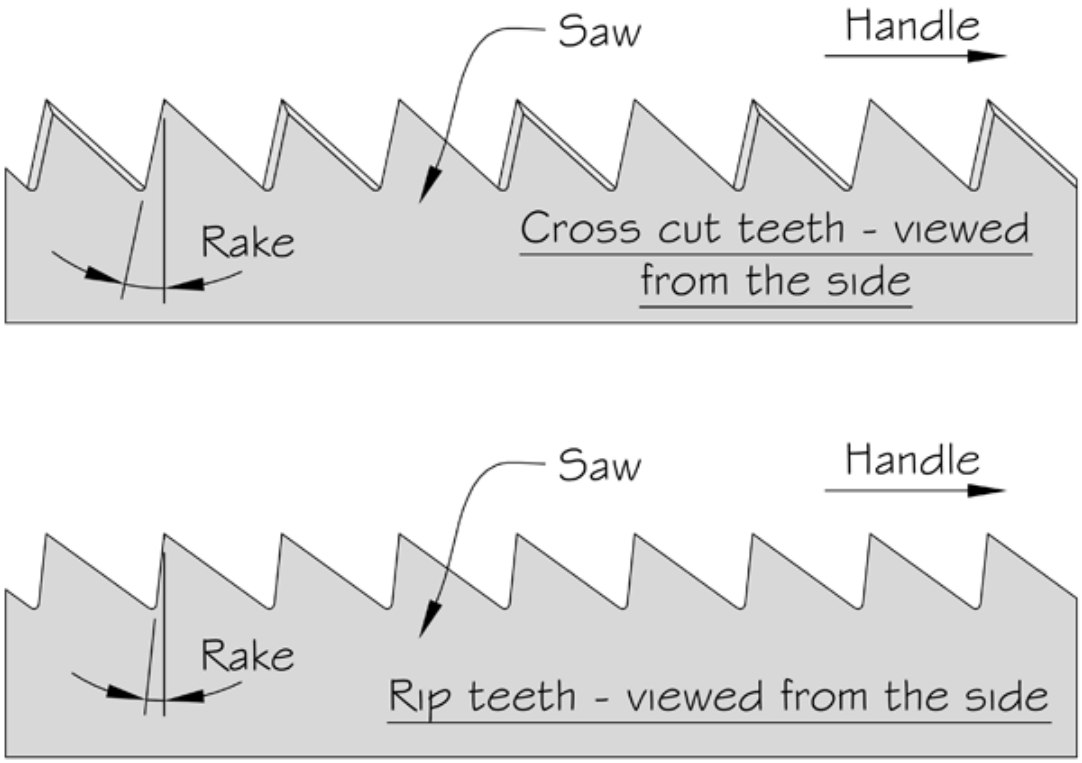

Figure 6. Rake on rip and cross cut saws.

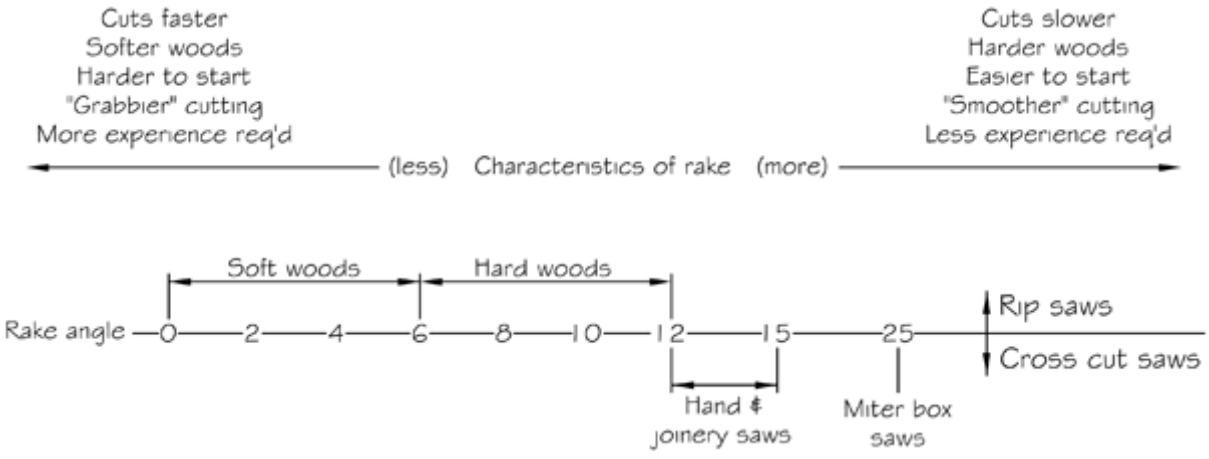

Figure 7. Rake guidelines and characteristics.

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Fleam (sometimes called bevel) is the angle that the front of the tooth makes with a line drawn perpendicular to the plane of the saw plate (Figure 8). Although fleam can be created by filing sloped gullets, the most direct method of controlling fleam is to swing the file from one side to the other so that the angle alternates from tooth to tooth (Figures 4 and 9). The main effect of fleam is on the smoothness of the cut. All other things equal, a saw will cut more cleanly as its fleam is increased.

In theory, a rip saw is filed with no fleam; in practice, a few degrees of fleam is often introduced so as to leave a smoother cut, especially on saws that may deviate from pure ripping (e.g., dovetail saws).

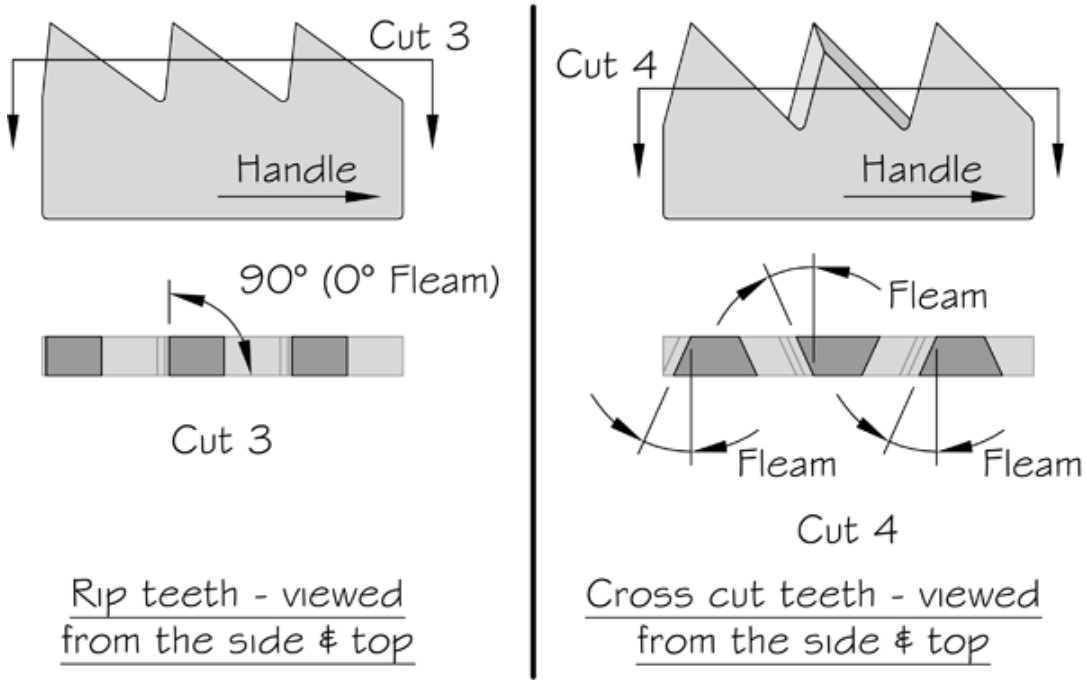

Figure 8. Fleam on rip and cross cut saws (no set shown).

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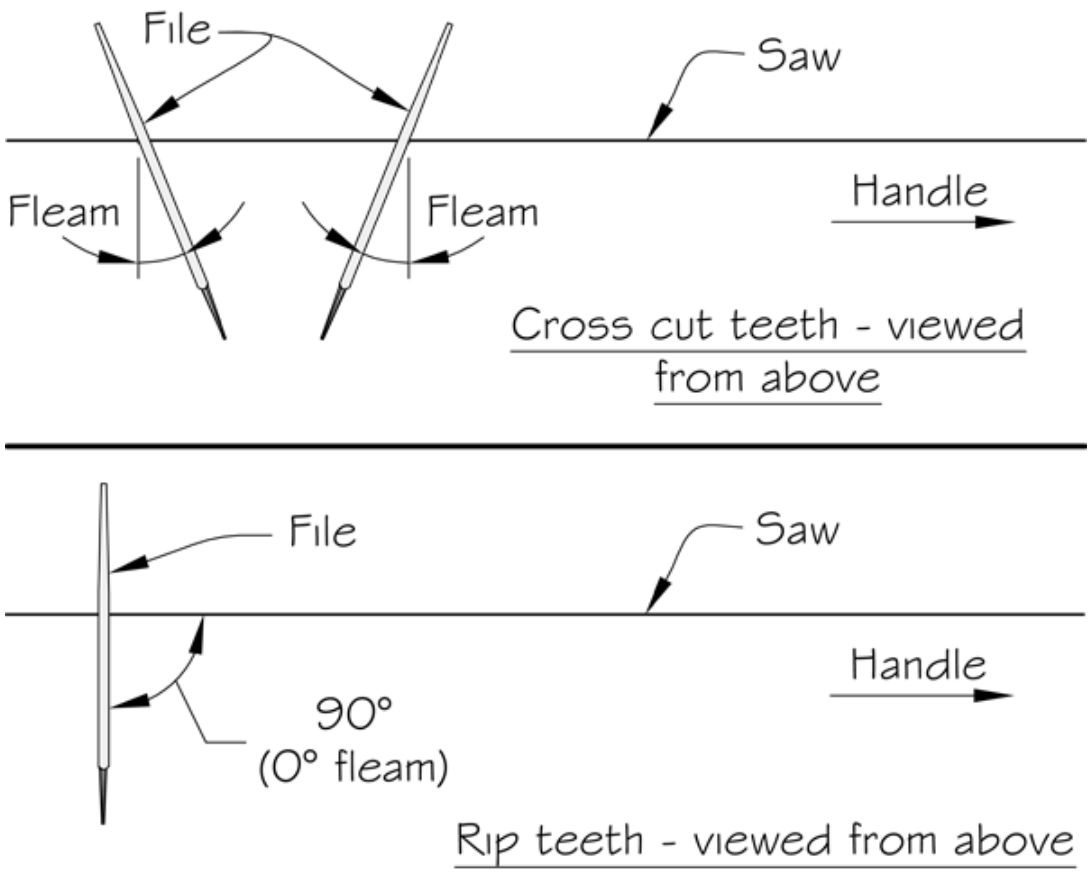

Figure 9. Filing fleam on rip and cross cut saws.

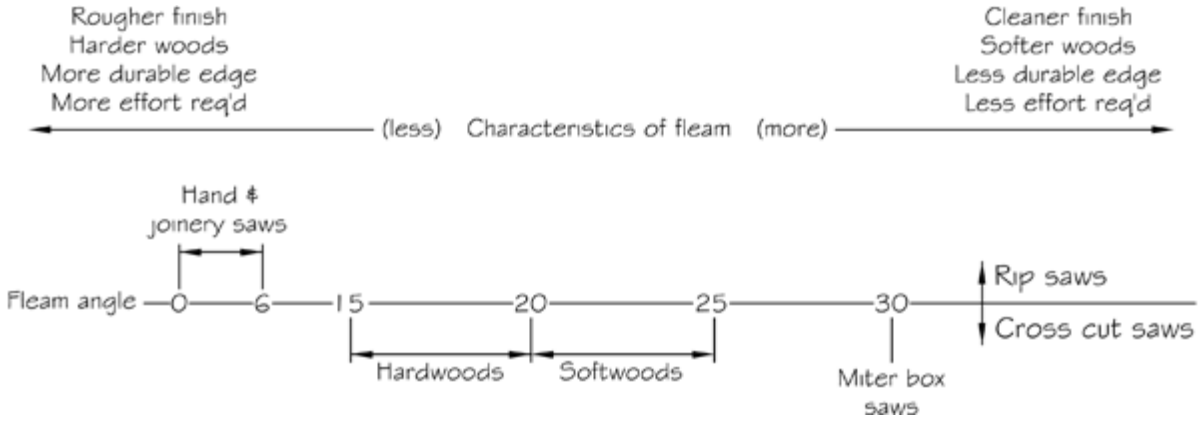

Figure 10. Fleam guidelines and characteristics.

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Point slope is the angle that the tip of the tooth creates with the side of the saw plate. Looking back to Figure 8, it is apparent that point slope is a byproduct of filing fleam into a tooth. Figures 11 and 12 show point slopes for rip and crosscut teeth.

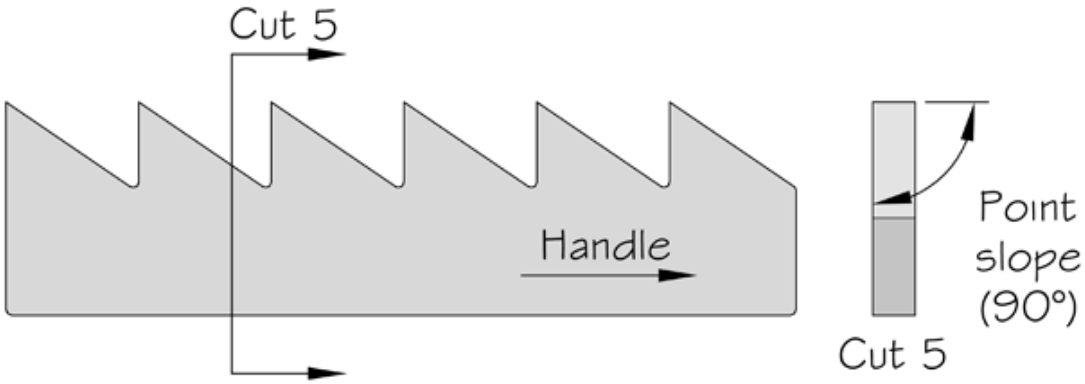

Figure 11. Rip teeth with unsloped gullets, viewed from the side and toe (no set shown).

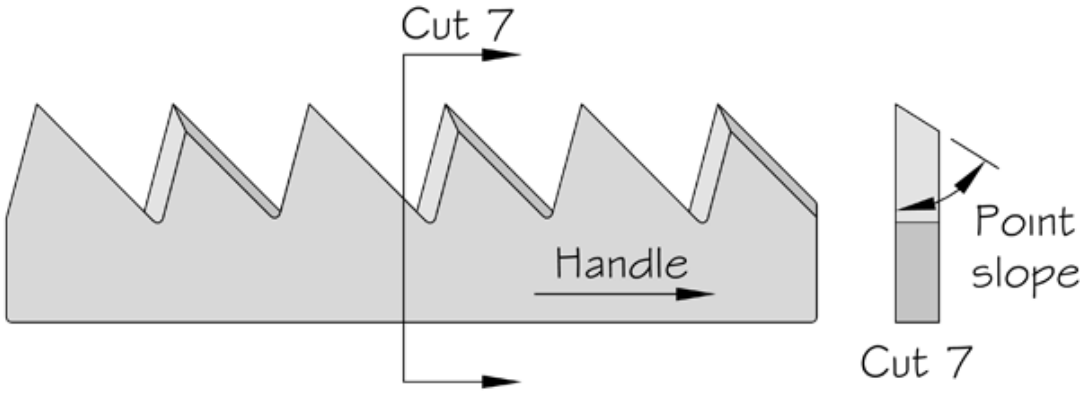

Figure 12. Cross cut teeth, viewed from the side and toe (no set shown).

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Sloped gullets are created by lowering the handle of the file vertically (Figures 5 and 19). Alternate gullets are sloped in opposite directions. Filing sloped gullets is beyond the scope of this class; please visit blackburntools.com for further discussion of this technique.

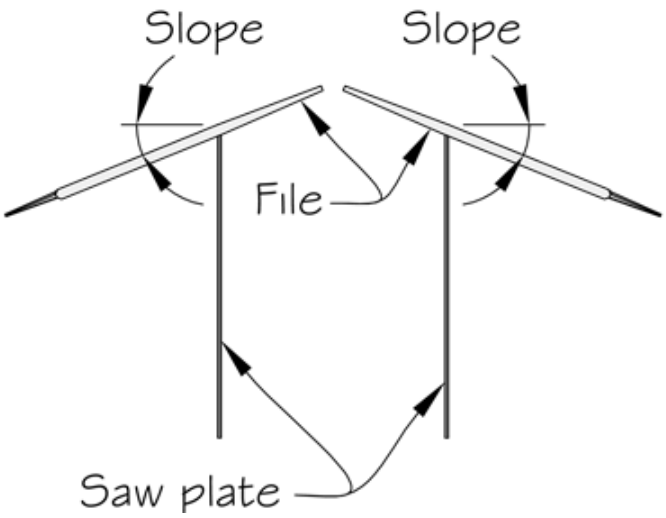

Figure 13. Filing slope on rip and cross cut saws, viewed from the heel or toe.

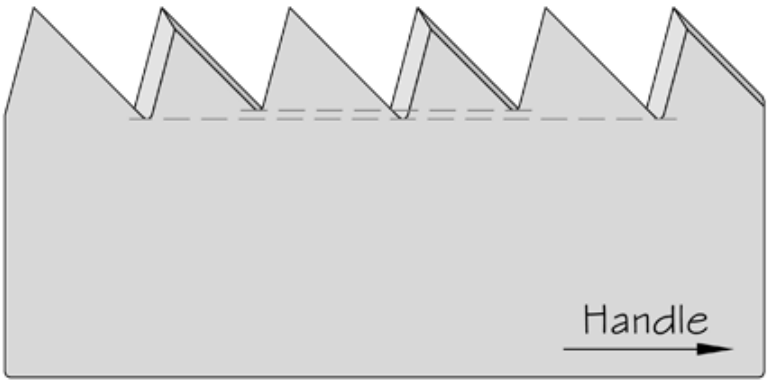

Figure 14. Side view of sloped gullets, showing alternating baseline.

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Set is created by bending the tips of the teeth in alternating directions. This creates clearance in the cut for the saw plate, reducing friction and binding. Figures 15 and 16 show this in rip and cross cut saws, respectively.

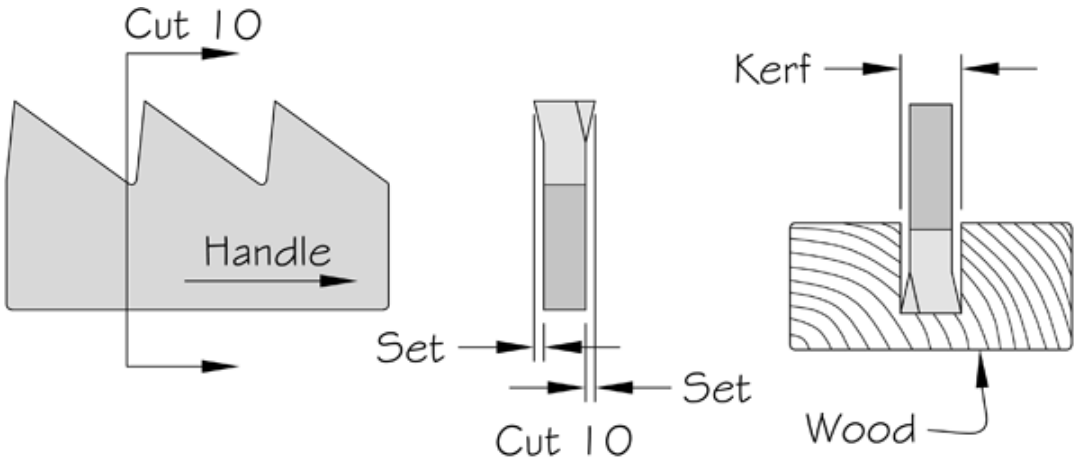

Figure 15. Set on rip teeth, viewed from the side and toe.

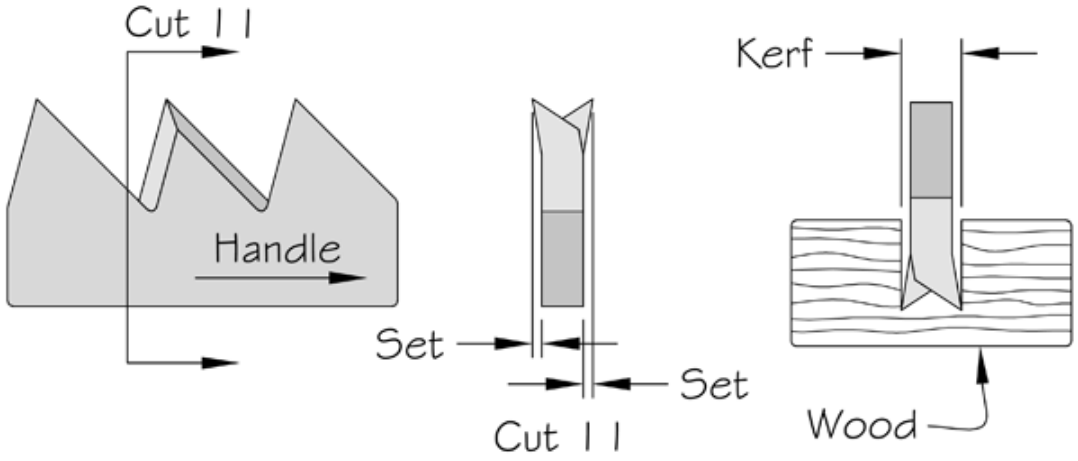

Figure 16. Set on cross cut teeth, viewed from the side and toe.

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Set varies from none on saws that are heavily taper ground and used in dry hardwoods, to a fortieth of an inch or more on coarse saws used in wet woods. The optimal amount of set varies, but in general, the least amount needed to prevent binding in the wood being cut will work best. Additional set creates more work (by increasing the amount of wood being removed) and decreases the quality of the cut.

Figure 17. Characteristics of set.

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Sharpening

Steps in sharpening:

1. Joint to even out tips of teeth.
2. File tooth to shape.
3. Dress sides of teeth / blade to remove any burrs.
4. Set teeth.
5. Light jointing.
6. Final sharpening.
7. Very light side dressing to remove burrs and even out teeth.
8. Test cuts.
9. Side dress the teeth to correct wandering tendencies.

A few random thoughts:

I file all of my teeth from one side, but there's nothing wrong with flipping the saw around and filing from both sides.

I prefer to work from the toe towards the handle of the saw. It gives me better vision of the teeth as I work on them.

I lift the file from the tooth on the backstroke – it makes it very easy to see how much more work needs to be done on the tooth.

A big part of sharpening is knowing which direction to steer the file so that the teeth come out evenly formed. I like to do most of the work on the back side of the tooth so that I don't need to apply sideways force to the file. I only remove enough material from the front of the tooth to bring it to a point.

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Rip teeth

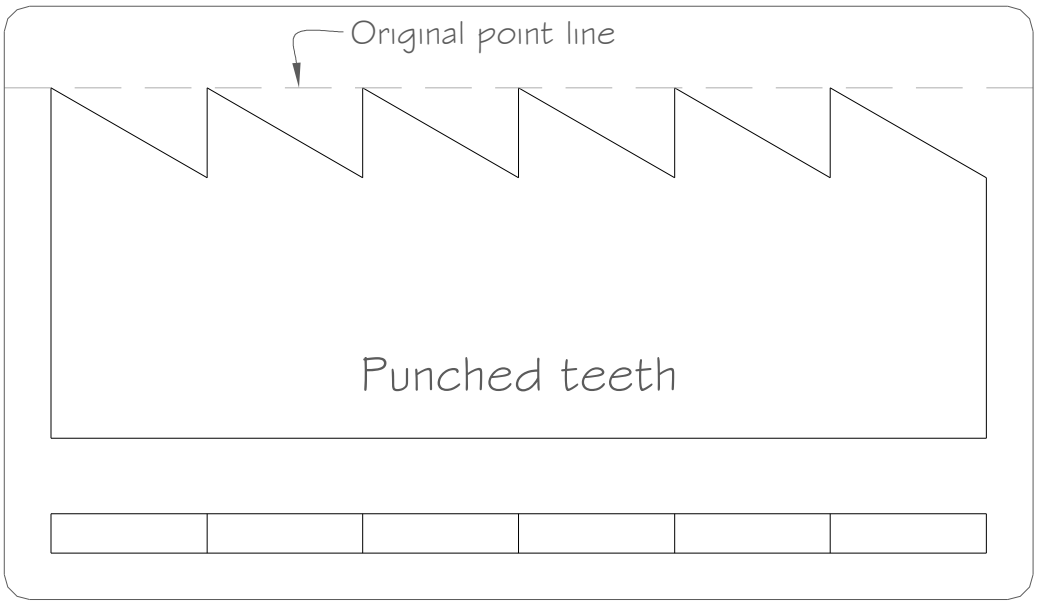

Figure 18

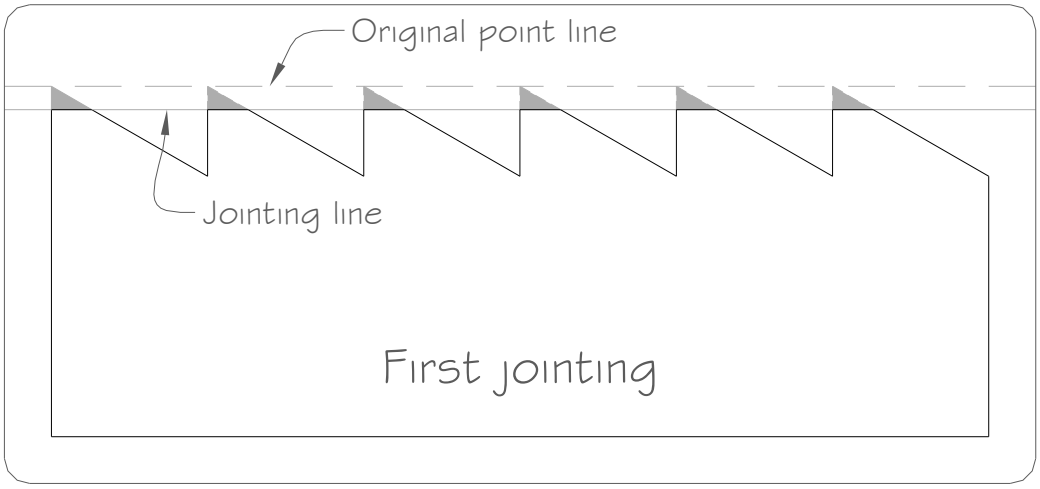

Figure 19

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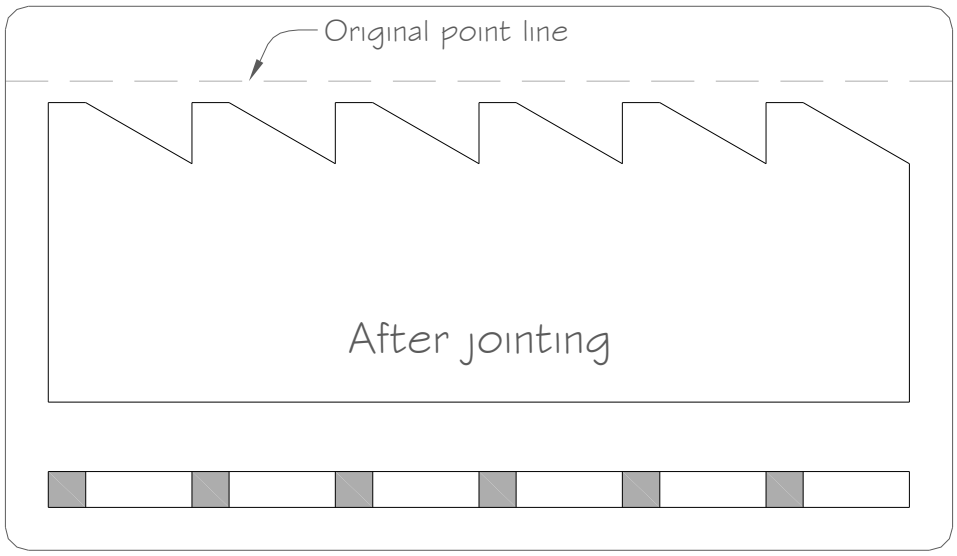

Figure 20

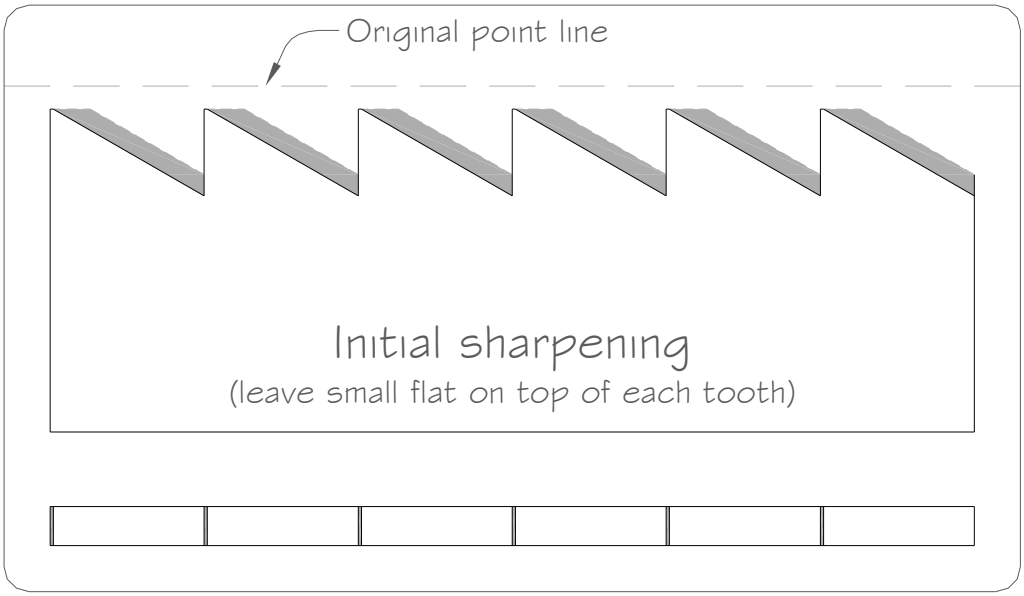

Figure 21

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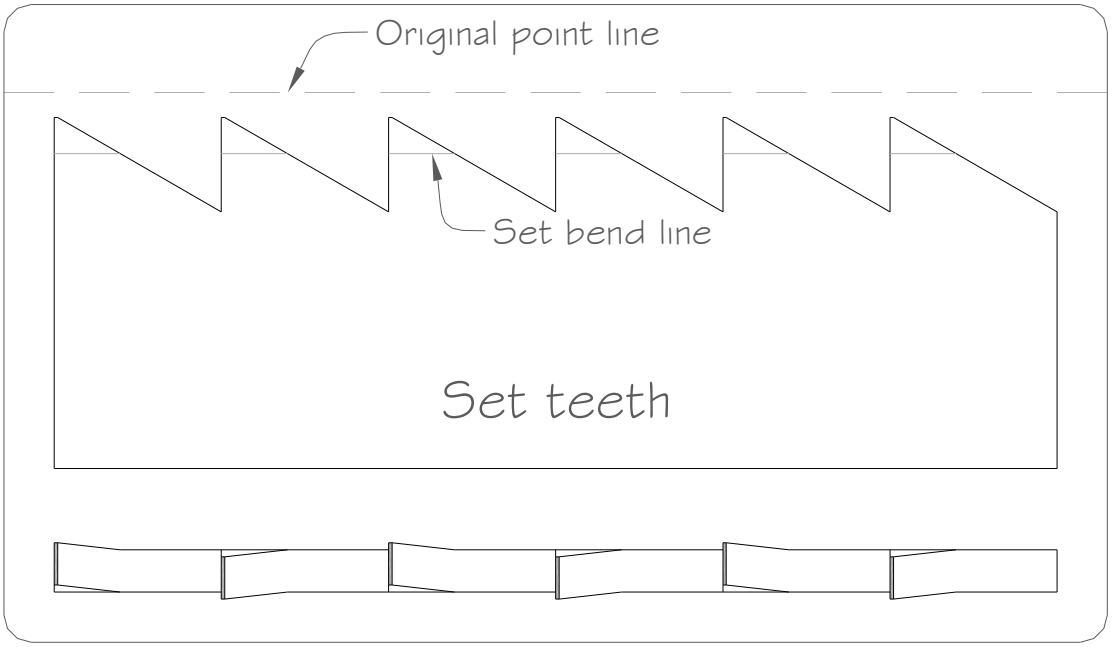

Figure 22

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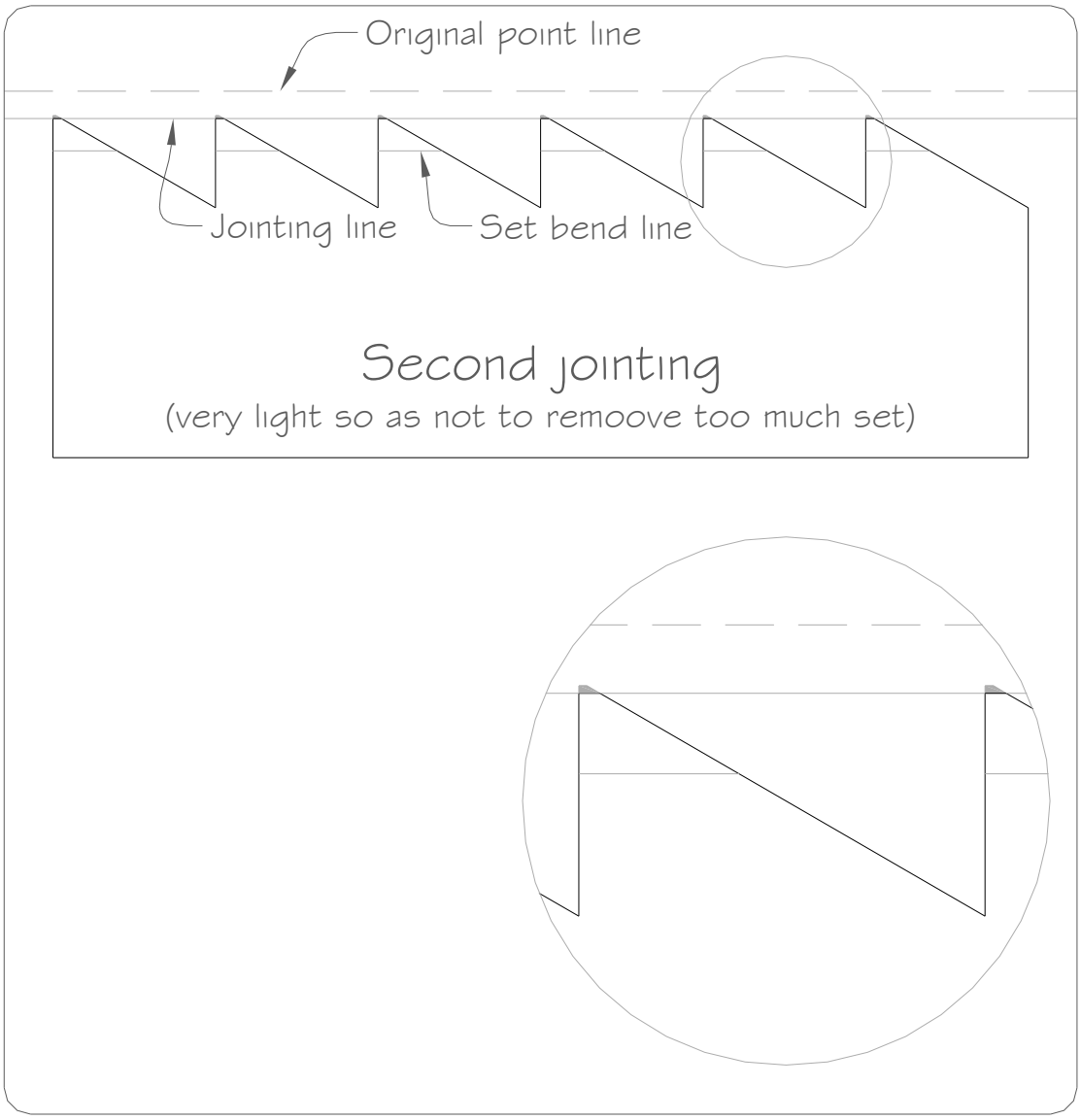

Figure 23

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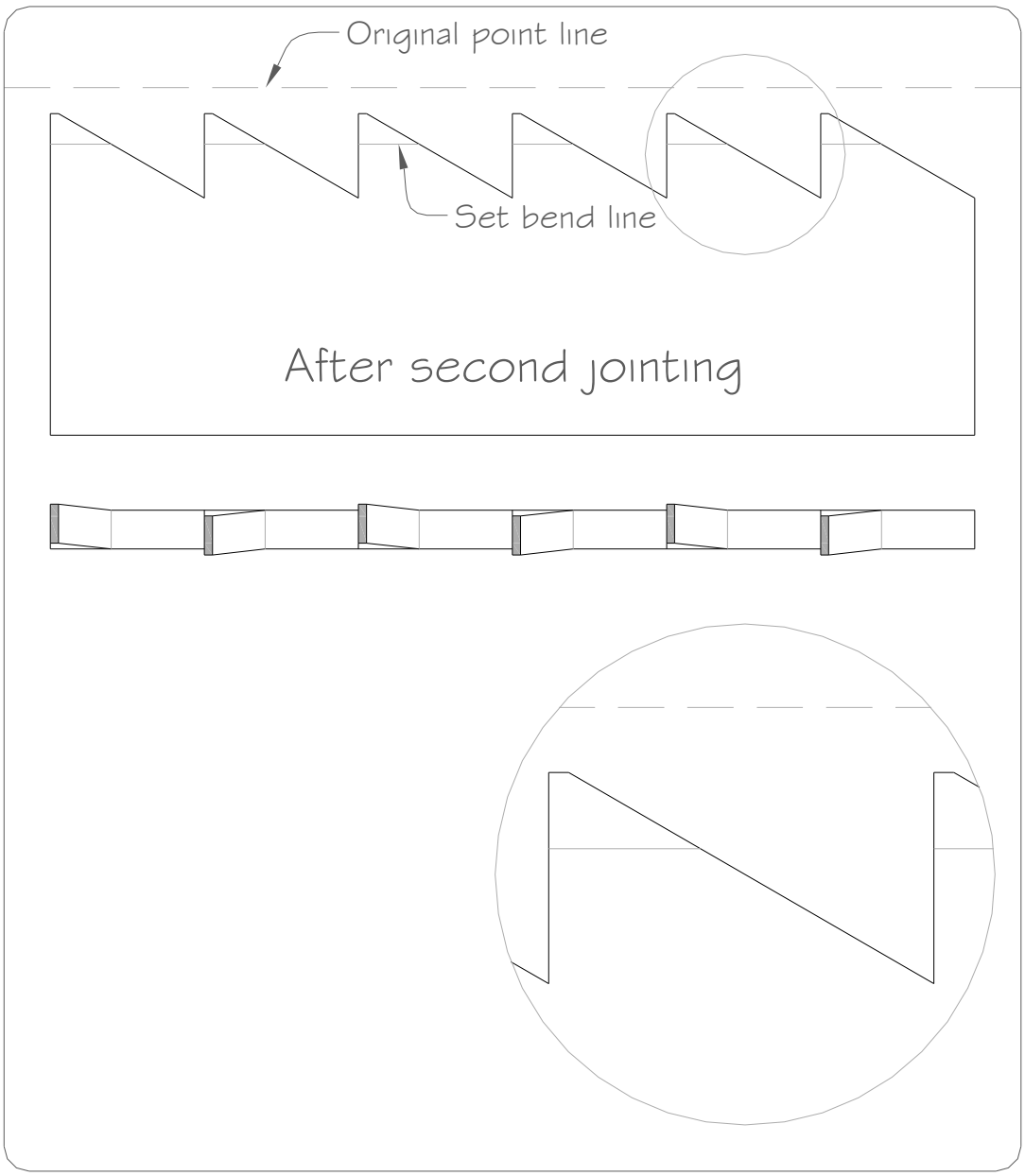

Figure 24

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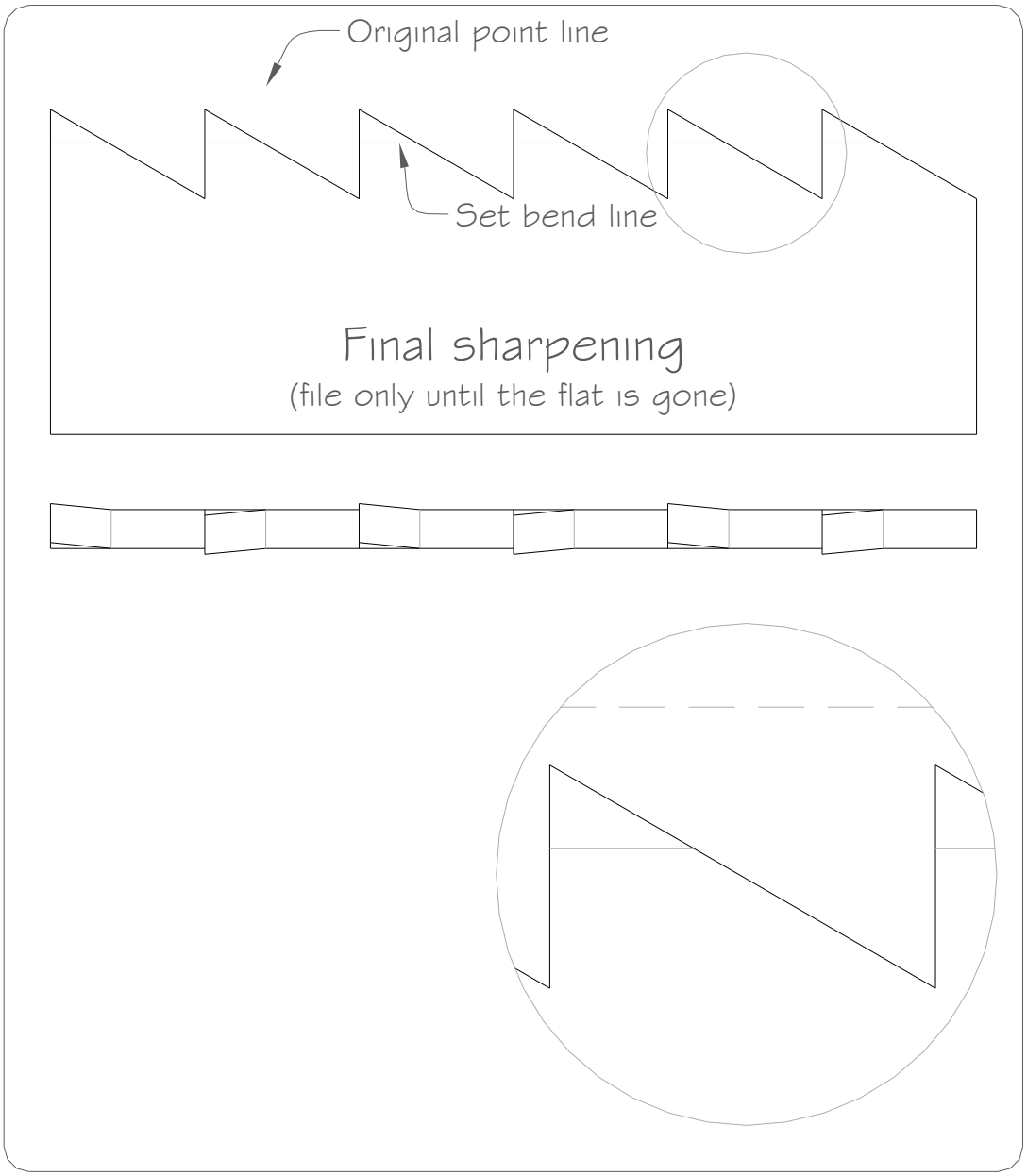

Figure 25

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Crosscut teeth

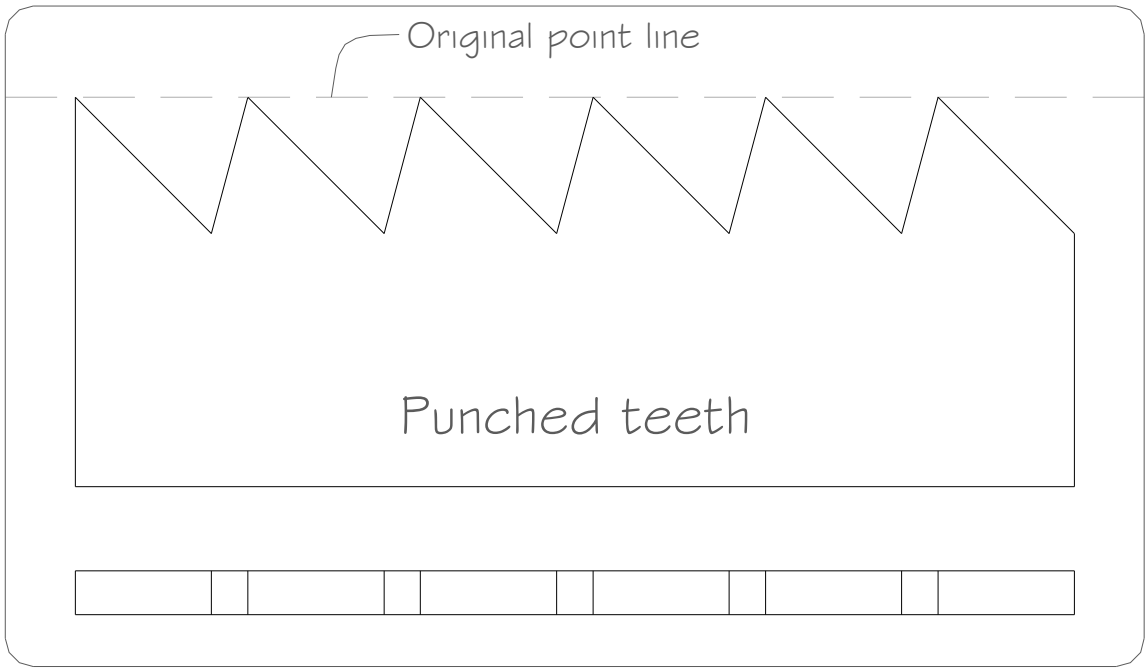

Figure 26

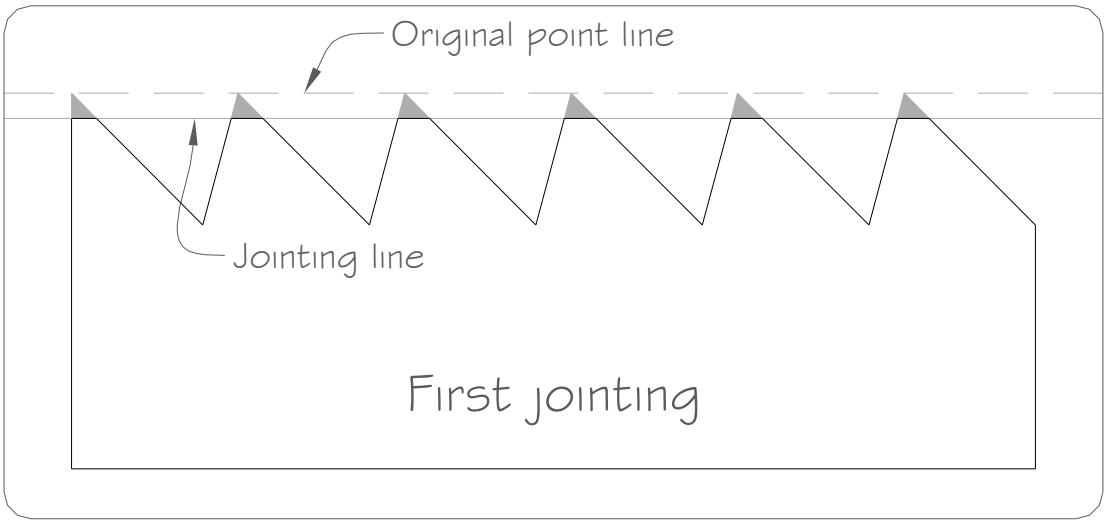

Figure 27

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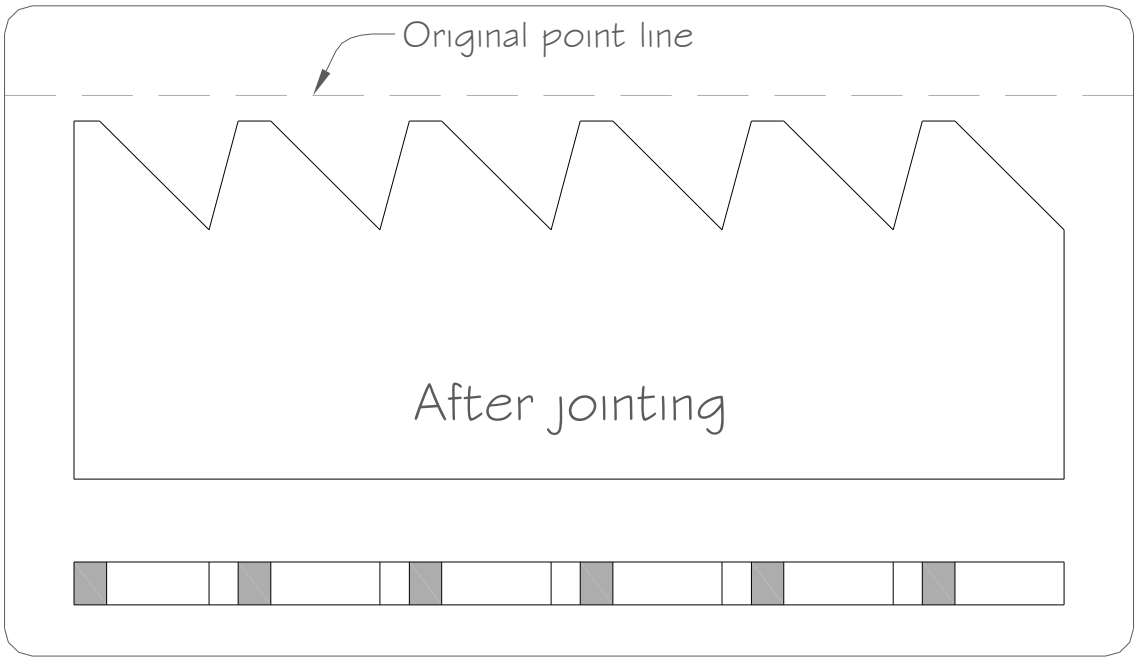

Figure 28

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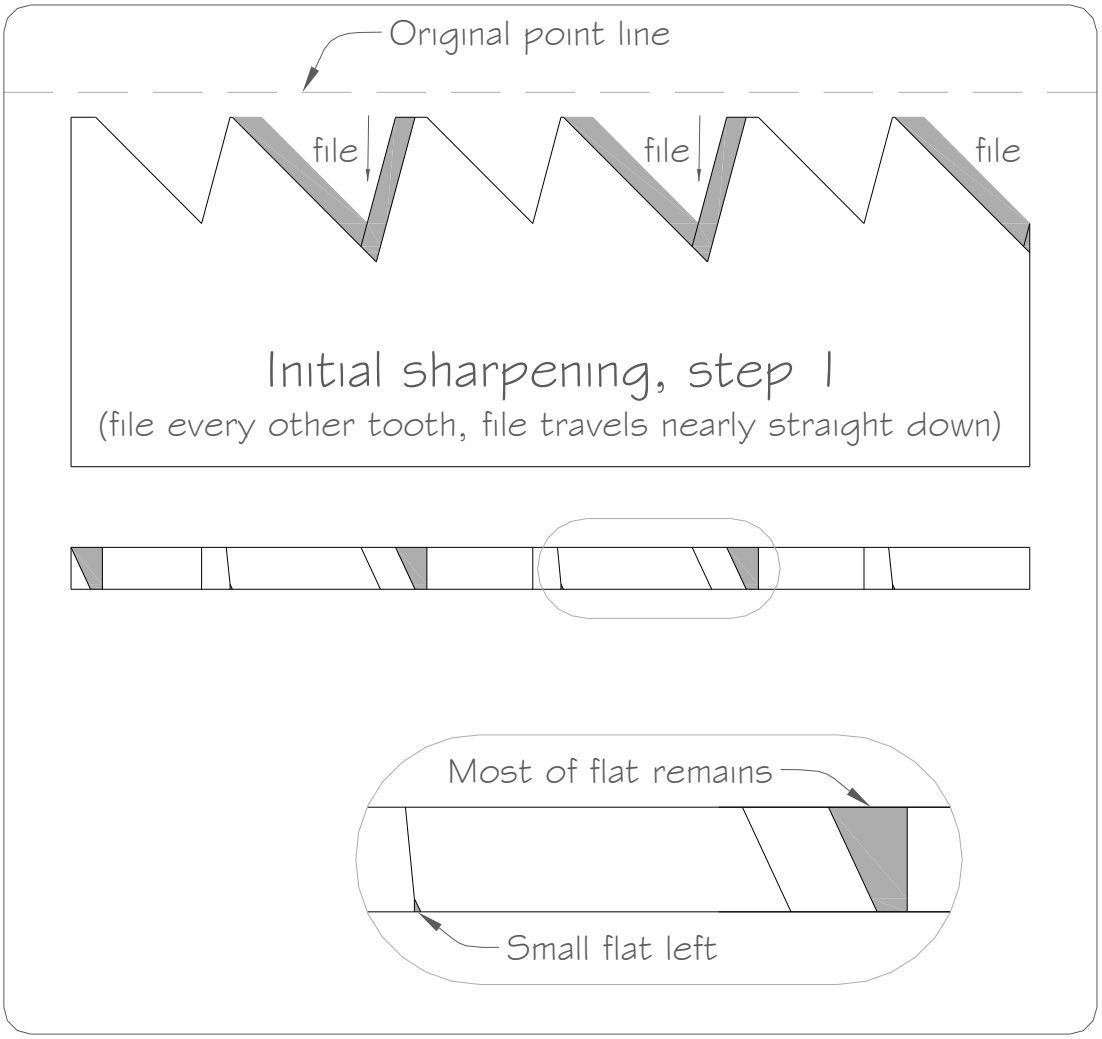

Figure 29

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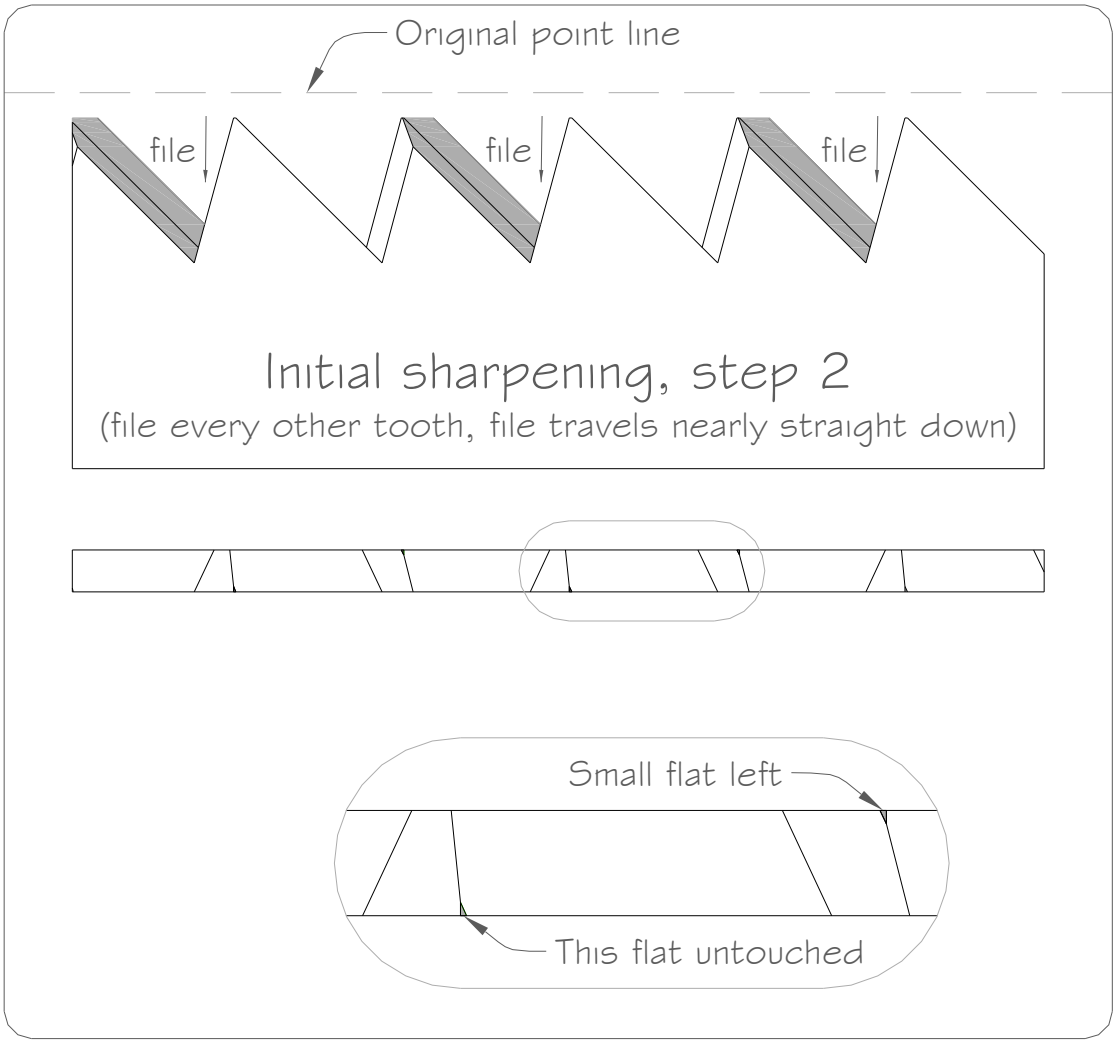

Figure 30

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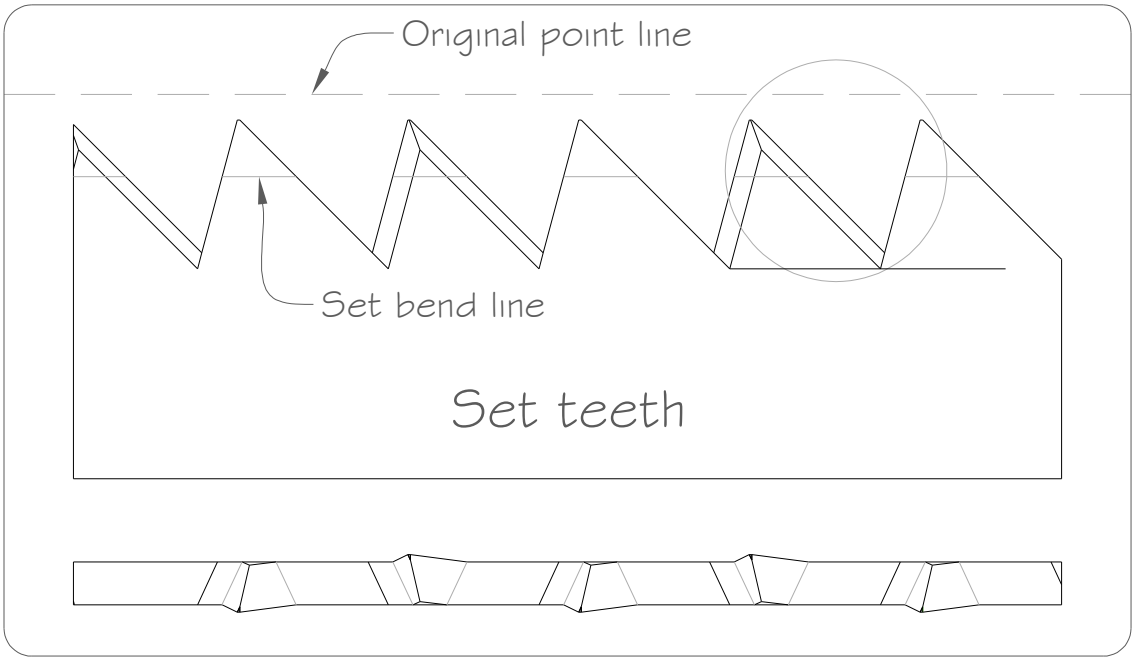

Figure 31

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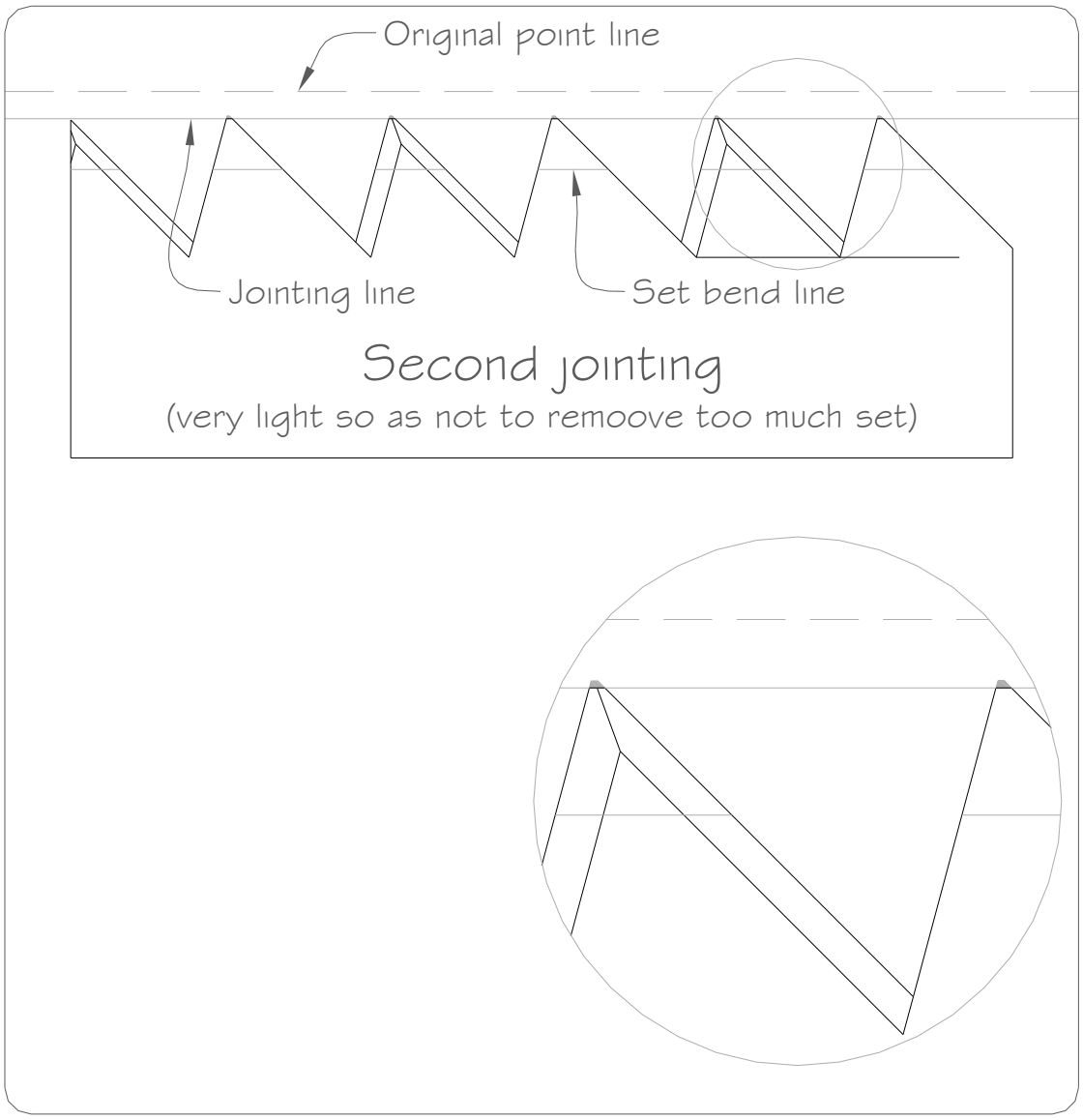

Figure 32

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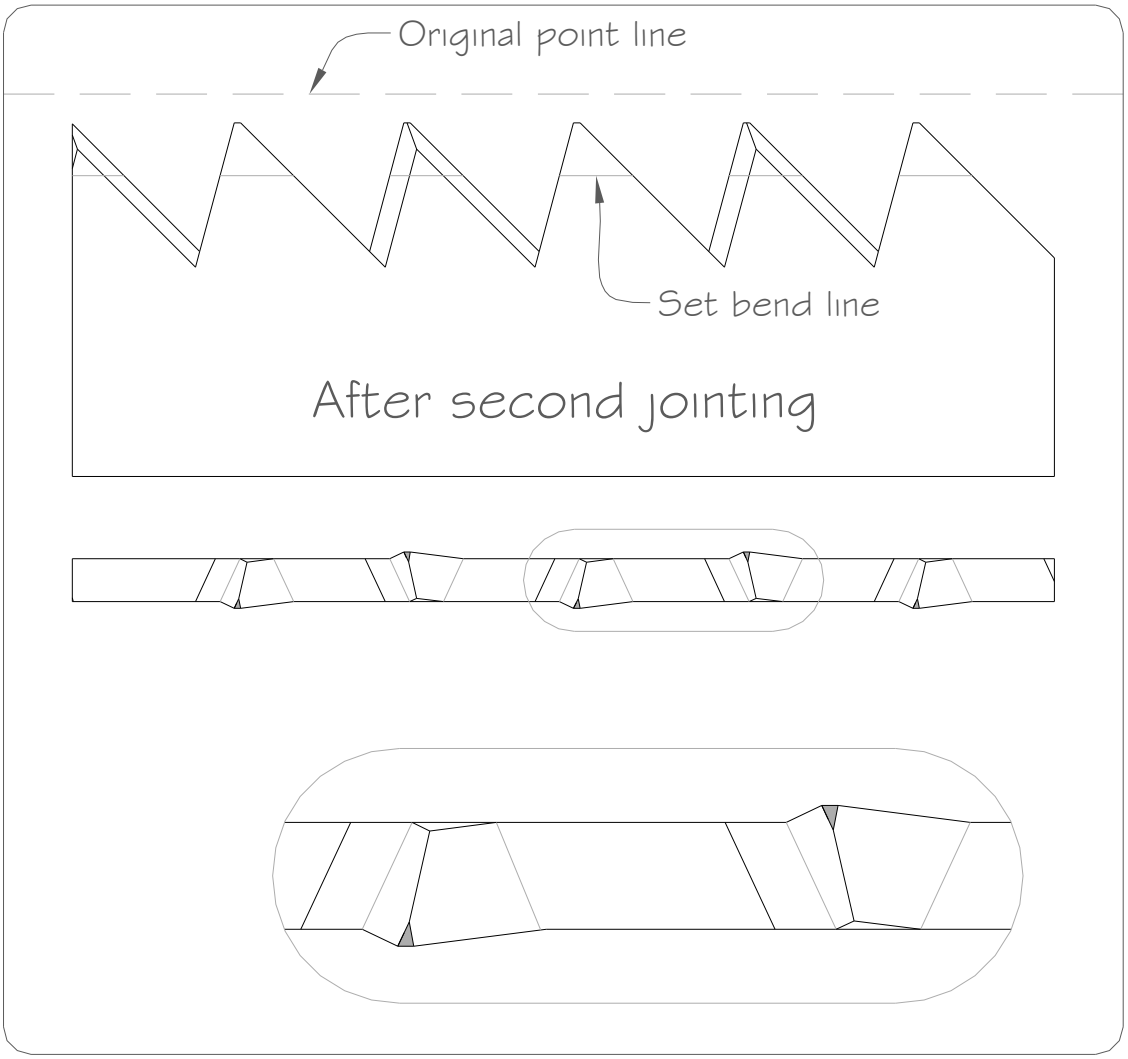

Figure 33

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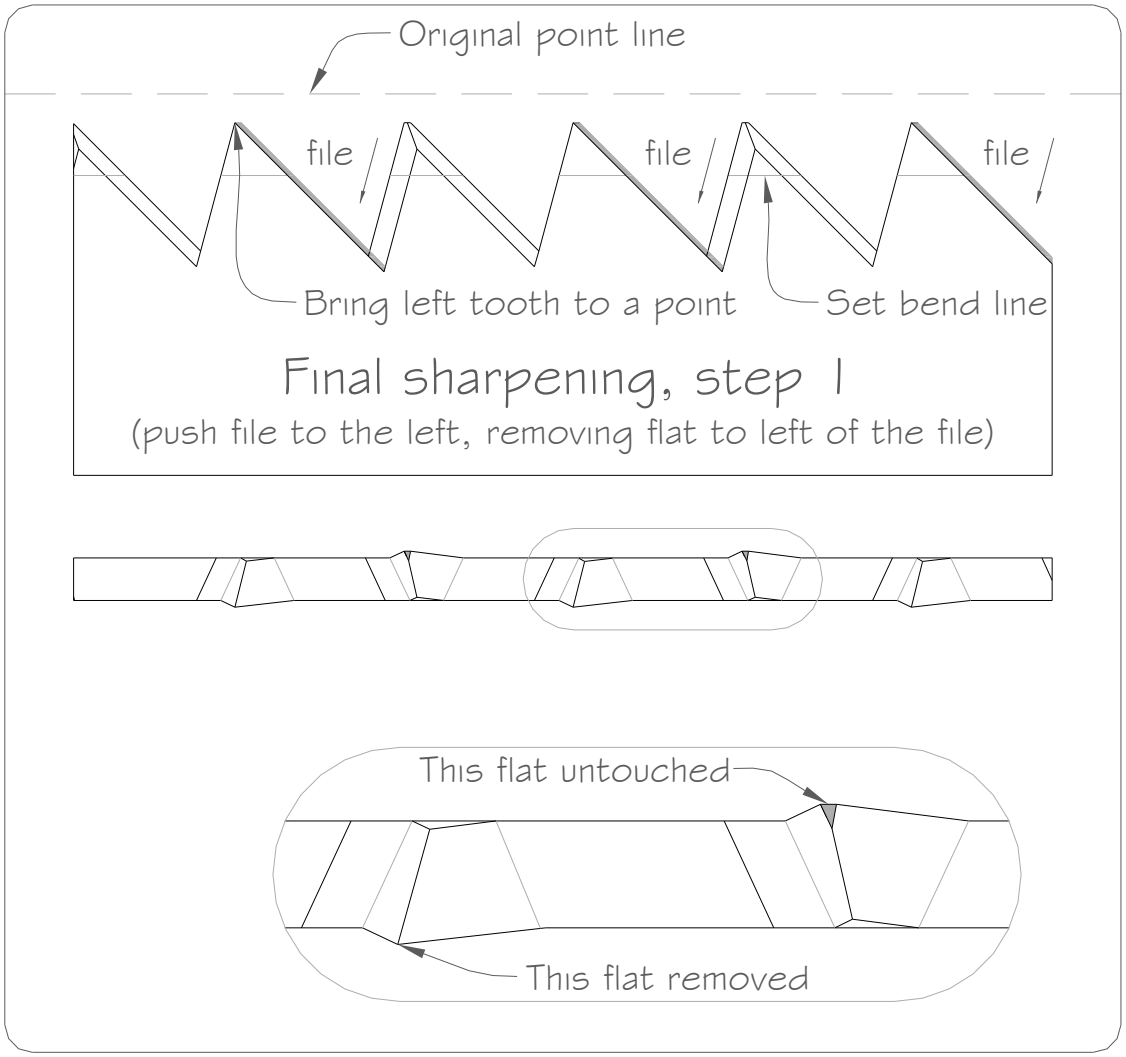

Figure 34

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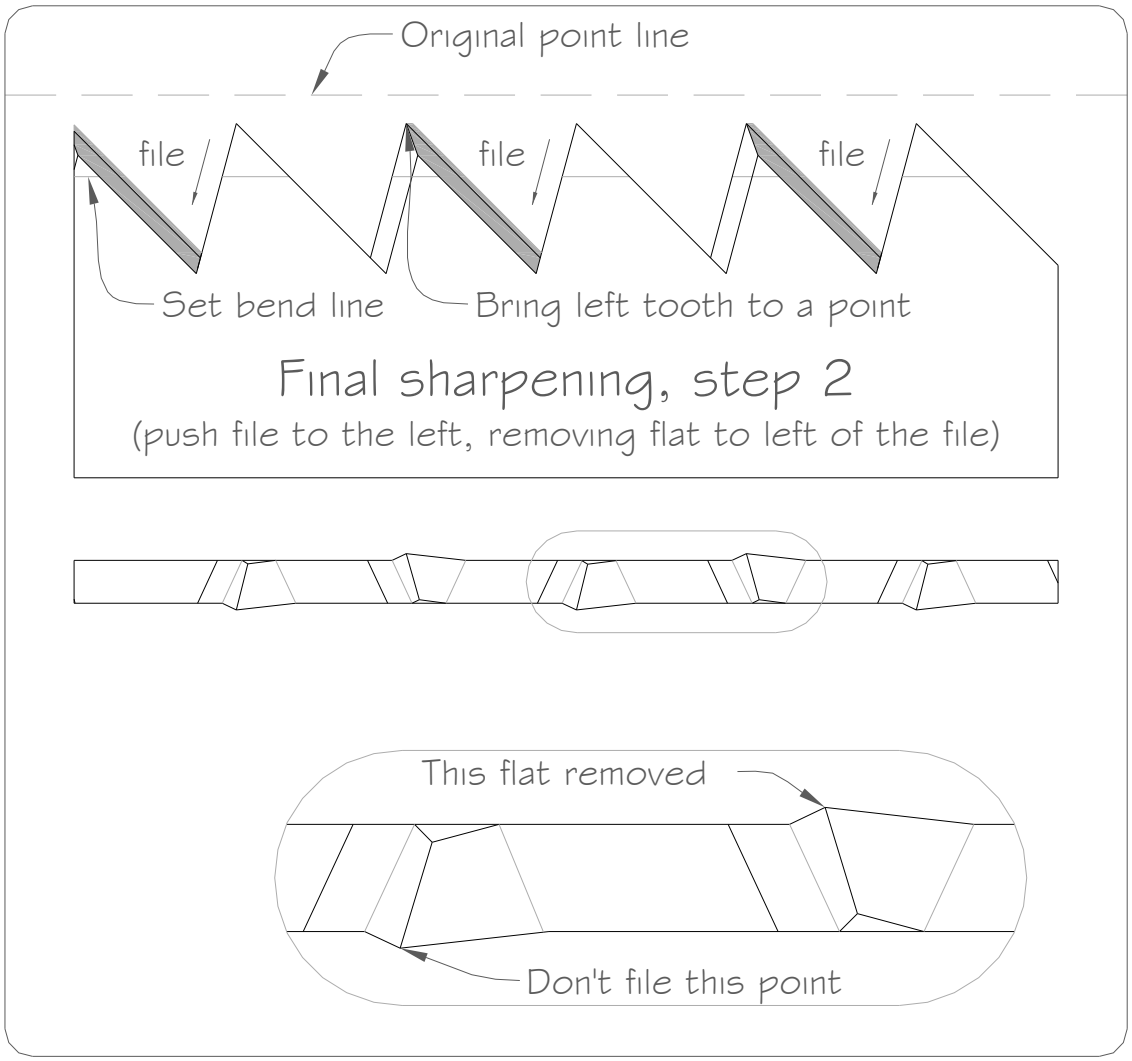

Figure 35

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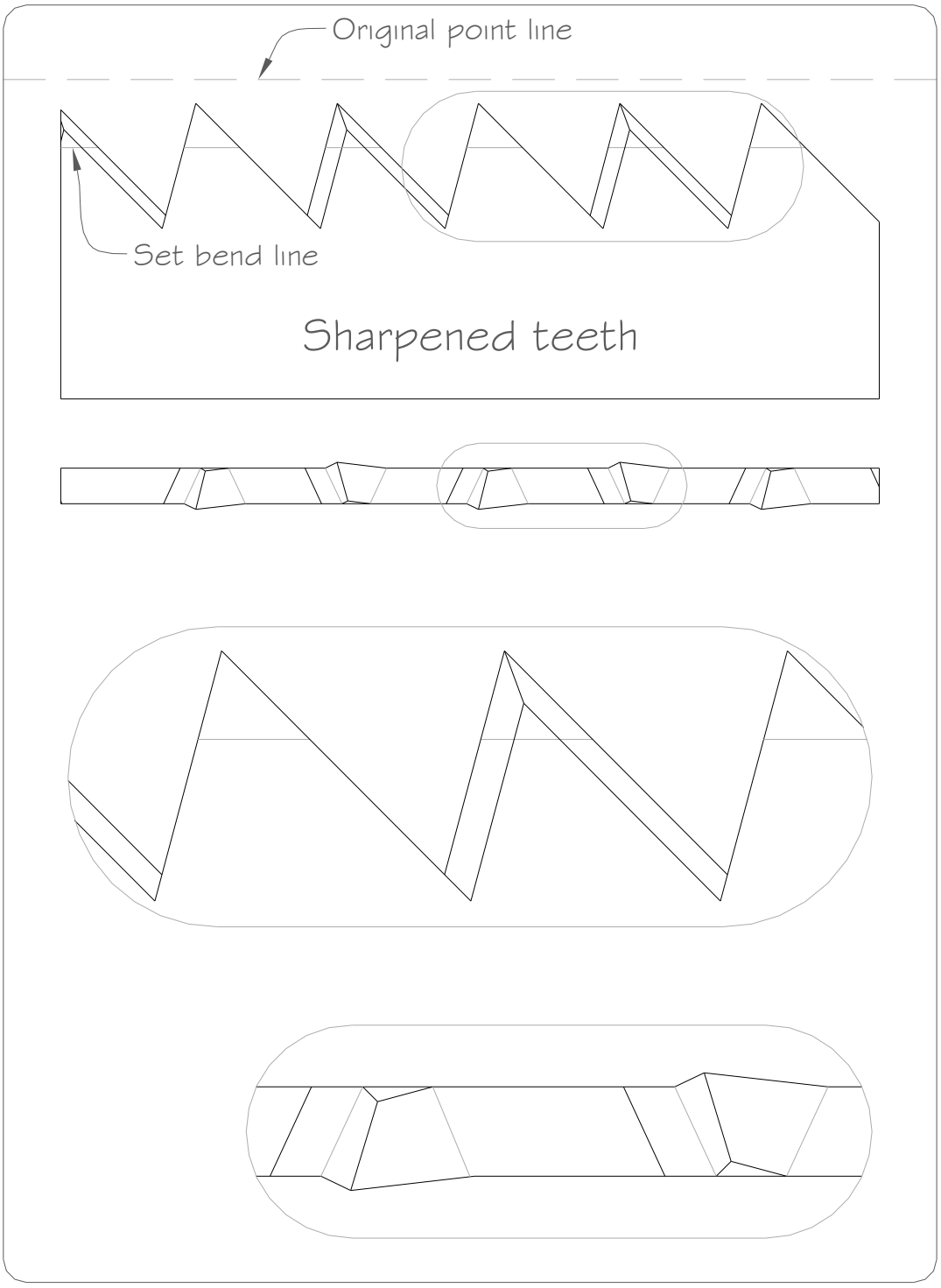

Figure 36

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