Why Pre-drilling and countersinking prevents wood splitting

This article explains the reasons for wood splitting, which occurs while joining two pieces of wood, using wood screws.

The most common wood screws are offered with a countersunk flat head.

When a screw is driven into a material without a pilot hole, it can act as a wedge, generating outward pressure, which can cause many materials to split.

We will deal in this article with the 2 most common solutions to solve this problem:

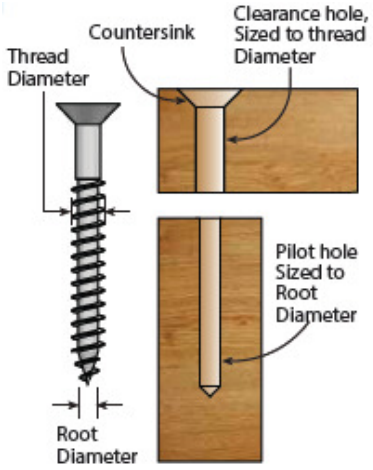
1. *pre-drilling*
2. *Using self drilling screws*

We will show that the 2nd solution is the less recommended one.

The conclusion of this article is that if you want professional results with no wood splitting for the long run, you certainly need a good quality countersink drill bit.

Before inserting the screws, take the time it needs to drill a pilot hole or a clearance hole or both, as well as a Countersink.

The following illustration briefly explains the terms that we are using.



Unfortunately, many inexperienced people are not aware of the importance of this operation of pre-drilling and tend to skip it. It happens also with those professionals who try to save time and money.
There are 2 main arguments to explain why skipping the predrilling operation is legitimate.

1. *It is not necessary while working with soft wood.*
2. *I am using self-drilling screws.*

Indeed, soft wood like pine is easy to work with and it is supposed to absorb some of the internal pressure caused by the screws. However, in this article we will explain the reasons why it is just a matter of time until one will see the splits in the wood.

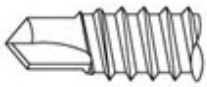
The necessity in developing self drilling screws, by itself shows that everybody agrees that pre-drilling is essential. The question is if these special screws do really resolve the splitting problem.
Let us first explain the idea of the self drilling screws before answering all the arguments behind it.

Self drilling wood screws and wood splitting

Many screw brands offer innovative screws with self-drilling and self-countersinking ability.

They are called “self-drilling screws”, “Self-Tapping Screws”, “Construction screws”, “cutter screws” etc.

Some of these screws are made with a thread cutting tip with sharp point that has been fluted to be able to cut and capture chips. Such screws are known as “Type 17” or “Auger point” screws.



Others are made with drilling points (2 or more) that can actually drill.

Obviously, there are many more sophisticated designs and patents that promise better performance.

This type of screws is supposed to save precious time, as you do not need to pre-drill the wood in order to avoid or reduce splitting.

We cannot agree with this statement and this article will explain why we argue about that.

Self-Countersinking screws are another innovative idea. Having “ribs” or “nibs” on their countersunk part of the head, they are supposed to do the countersinking (cutting) job saving the time of a separate countersinking operation.

Again, we cannot agree with this statement and we will explain the reasons in this article.

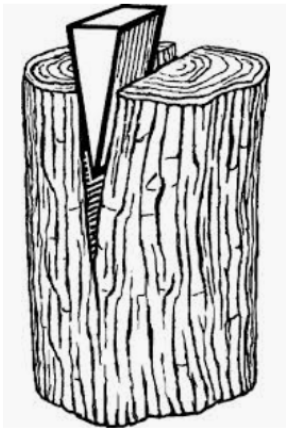
Let us sum up the relevant arguments made about the “self-drilling” and “Self-Countersinking” screws.

1. *They prevent splitting when screwing close to the edge.*
2. *No need to pre-drill the wood.*
3. *They have the ability to penetrate almost all timbers without drilling a pilot hole.*
4. *Time saving - they operate quicker.*
5. *The nibs on the screw head allow self-countersinking. No need to use a countersinking bit.*

Follows our detailed answers to these arguments and some additional points:

1. Argument: *“Self-drilling screws prevent splitting when screwing close to the edge.”*

   There are no miracles.



   The volume of the screw (Mainly, its core and its head) is added to the wood when it penetrates into it. The wood must “open” – expand, in order to create room for the Screw.

   Wikipedia uses “wedging” as the term to describe what actually happens when a screw is driven into a material without a pilot hole “it can act as a wedge, generating outward pressure, which can cause many materials to split. By drilling a small pilot hole in the material, into which a screw is then driven, less wedging takes place, thereby reducing the likelihood of the material being split”.

   When you insert a screw or any other body into the wood, you generate pressure inside the wood. The wood fibers are pushed away from the area of the Screw. It is even more crucial when screwing close to the edge of the board, where the ability to absorb the pressure is reduced dramatically.

   Obviously, not all timbers act the same way. In soft wood, you do not feel it so much, but in hard wood, it might be critical. For example: Pinewood can handle the expansion a bit better than Oak. The Oak, has a more complex structure than pine, so it is more difficult to drive screws into it.

   The common professional solution is to pre-drill a pilot hole. This operation removes most of the unnecessary wood material, allowing the screw to penetrate with a minimal pressure.

   Different innovative designs of the screws could indeed help to minimize the danger of wood splitting by dispensing the wood fibers. Less pressure is created, which is a very positive thing. However, it hardly removes any material from the wood.

   Therefore, we remain with the same problem that I described - the volume of the Screw is added and creates pressure inside. The question is if the wood can absorb this pressure without expanding, which means - without splitting or bending. In many cases, it fails.

   The bottom line: I tend to believe that comparing to other simple wood screws, innovative screws reduce the phenomena of wood splitting, but they certainly cannot prevent it, especially for the long run and certainly not in the case of hard woods.

2. Argument: "*We used these screws without predrilling and it looks perfect!*"
   Splitting does not necessarily happen or seen at the first moment of inserting the screws.
   Skipping the pilot hole, or drilling one too small, can create hairline cracks, especially in solid wood and MDF. Such cracks can eventually develop and grow slowly but surely. This could happen after short time or after a few months or even longer because of the changes in moisture levels (humidity) and in the temperature of the wood. When it dries, the wood becomes less flexible - more fragile. It shrinks, expands and bends as well.
   What makes it worse is the fact that we have two pieces of wood joined together. Not always, the wood is identical in both of them and they are different in shape, in fiber direction as well as in their dimensions. Therefore, their expansion and their ability to absorb the expansion and the pressure created from the screw are never identical. During the time, deformations might occur and splitting develops in the weakest areas.
   Altogether, the fact that you don't see it immediately, doesn't mean that splitting will not happen eventually.

3. A question: *"Is the splitting problem different in outdoor applications?"*
   Yes and no. The same principles work in all the applications.
   It is obvious that weather condition like temperature changes, sun, rain and snow have a big effect on timbers. Therefore, while making wooden houses, terraces, garden furniture, decks etc. we must take more precautions than in the case of indoor jobs.

   The expansion or shrinkage of the wood, especially when large or long bodies are used, means that the distance among the original locations of the screws is changing. However, the top board and the bottom board do not necessarily expand or shrink identically. This fact generates big pressure on the screws. If the screws do not have some space to move, they might cause wood splitting and even bend or break.
   The best solution for this problem is to predrill a clearance hole.
   Obviously, no "self-drilling" screw can offer that. Hence, drilling a clearance hole in outdoor jobs is even more crucial for professional results with minimal wood splitting.

4. Argument: *“Using our screws, you need to predrill only while using hard wood.”*
   Pre-Drilling is unavoidable regardless if you are building the deck from soft wood or from hard wood.
   This argument ignores the weather factor and its consequences for the long run on any kind of wood. Soft wood does not necessarily bend or expand less than hard wood!

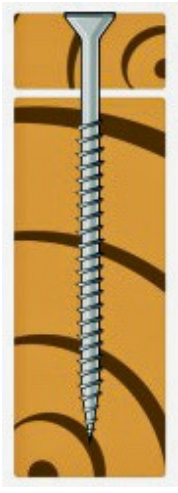
5. Argument: *“Our screws are Self-Countersinking… No need to pre-countersink!”.*
   The same arguments regarding the necessity of removing wood material to make room for the screw, apply to the screw head. The ribs (nibs) in the self-drilling screws have some “countersinking” action, but they are not sharp enough to cut and definitely far from being real Countersinking bits. They do “push” some wood outside, but they don’t really remove material to create enough room for the screw head.
   One should use a real cutting tool - a countersinking bit, to create a countersink in the wood for a better seat of the screw without unnecessary inside pressure.
   Avoiding the extra operation of countersinking with a real countersink bit (like WPW one) will again result bigger pressure on the wood with all the consequences.
   In fact, the stage when most of the splitting becomes significant is when the screw (countersunk) head is pushed down into the wood.
   At this moment, failures in the screws might cause them to break, especially when inserted in hard materials. Such failure usually only happens with low-quality screws, but it is surely something to be aware of.

6. Argument: “*the ribs under the head enable the screw to sit flush and tight”.*
   As the top part of the head screw is round, without ribs (nibs), it blocks the chips (if created at all by the “ribs”). In order to sit more or less flush, you must push the screw down with some power, depending on the timber. This can be easily done by “impact” screwdriver machine on soft wood, but less easily in hard wood.
   However, such operation cannot ensure that all the screws will sit in the same depth.
   The final position of the screw depends on the user (how much power he uses), in the machine and its speed and in the wood hardness.

7. A question: "*How can we keep a uniform depth of the screw heads (flush or a bit below the surface of the board)?"*
   In order to achieve that, you must have a depth stopper mounted on your drilling / countersinking tool. No "self-drilling" screw can guarantee it.


   Is it important? Yes, if you care about having a professional result for your job.
   If you really care about the finish, it is better to use a revolving stopper that stops when it touches the wood, leaving no scratches and no burn marks.

8. Argument: *"Fast and easy penetration … without pilot hole"*
   Yes. The self-drilling screws can penetrate using less power than regular wood screws. However, as explained, most professional woodworkers agree that using such a screw does not really save us the pre-drilling operation. In addition, if you already drilled the pilot hole, penetrating would be fast and easy anyway.



9. A question: "*Do self-drilling screws have any effect on the holding power?"*
   Pre-drilling in the top board is needed not only to prevent from wood splitting. It is also essential to ensure a tight joint with long lasting fastening power. For best results, the screw should pass freely through the top board and then to engage only the bottom board. you'll get the most effective and longest-lasting fastening power from screws when you drill correctly sized **clearance** and **pilot** holes.
   This is true for any job of joining wood with screws, but most users ignore it because it requires 2 drilling operations, or using relatively expensive special drills, like stepped drills or tapered point drills.

The screw head pushes the top board down towards the bottom board. Such pressure is needed to prevent from a gap left between the boards. If such pressure is not created, and the two boards have not been pre-pressed effectively against each other by a vise or another way, there might be a small gap between them. Such a gap means a weak joint.

One of the methods to strengthen a joint would be to apply glue between the boards. Glue can bridge a gap only if the gap is extremely small.

Self-drilling screws are designed to drill, which means to cut the material into chips. Some of these chips remain compacted inside the threaded area of the screw; hence, the grip of the threads weakens!

Professionals who have been using these screws know that in order to maintain a good - strong holding power, one would need to use more screws to compensate the weak grip of the screw.

10. A question: "*Is the extra money paid for these screws worth it at all?"*

    It should be considered because when you drive a screw through a pilot hole, it is an easy and fast job anyway. Therefore, in that case, the main advantage of these screws is lost.

    On top of it, you will need more screws for the same job to compensate their weak grip.

    In any case, we recommend using good quality, strong and long lasting screws.

11. A question: "*Is it always necessary to drill a pilot hole?"*

    When doing rough construction or building some furniture for your garage, you don't need it. In such cases, the easy penetration of such "revolutionary" screw would be an advantage. You will pay some extra money for the screw, but your job could be easier and faster than while using a standard cheap wood screw that might even break if not handled carefully.

    However, when you are working on a fine professional project, it is worth the extra couple of minutes to make the best possible joinery, keep everything flush and clean for long term.

12. A question: "*What about Decking? With so many screws to insert, can we save the extra pre-drilling operation?"*

    No way! The professional way in decking jobs, is to drill a clearance hole, which should be slightly larger than the Diameter of the screw in its upper part, below the head. However, no pilot hole is needed in the bottom board.

    A clearance hole ensures a tight joint, allowing the screw to pass freely through the top board. The screw must engage only the bottom board as explained earlier.

    No pilot hole is needed in the bottom board as it is normally made of soft timber and we do not care if it will split here and there, as long as the splits are not seen.

    The hole Diameter depends on the screw. If the screw has a thread all the way ("fully threaded" screw), there is no doubt that the clearance hole must be slightly bigger than the thread Diameter.

    In a partially threaded screw, the upper part of the screw is not threaded. Therefore, one may be tempted to drill a smaller clearance hole – not allowing the screw to pass freely through the top board.

    While using self-drilling screws one might be tempted to skip this operation completely.

    Let us make it clear - it is always recommended to drill the clearance hole slightly bigger than the thread Diameter!

    In decking jobs, weather changes enforce us to take more precautions than in the case of indoor jobs. As explained earlier, the expansion or shrinkage of the wood results in changing distance among the original locations of the screws. If the screws do not have enough space to move, they might bend or break and cause wood splitting.

    Therefore, for the long run, we cannot avoid the pre-drilling operation. The countersink bit, equipped with a decent stopper is definitely needed to create a countersink in the wood, in order to easily set the screws uniformly flush or a bit below the surface of the board, and prevent splitting.

We certainly hope that all these arguments will help you to make the right decision and enable you to do a better job while joining two pieces of wood, using wood screws.

Michael Ravid, WPW-TOOLS.com February 28, 2020