Shop Practice X3
Charlie Reiter
Drills and Drilling

This is a big subject. There is no other shop process that is used more often than drilling and, so often we just go ahead and drill without even thinking it through. “Just pop a hole in it” and that is of course an expedient and praise worthy attitude but it also is the hallmark of the casual and inaccurate machinist.
We do it so often that we don't give it much thought, and we rely on previous experience to guarantee the results. So many times I have drilled without adequate preparation and the results have been less than stellar. The hole that is slightly off or out of round or even, oddly, the wrong size all use up our available shop time to remedy the problem. I chastise myself for not taking the time or not being bright enough to visualize the outcome but then I do it again. Certainly work holding plays largely into this.
Using a starter or center drill is good practice and making a punch mark for the drill to pick up is necessary. Here I will say I do not recommend “automatic” center punches. The common prick punch and a light hammer is far superior. Yes you can screw it up and punch off center but at least it's you not the tool.
Larger drills have a very pronounced center flat wedge which is being pushed into the work. It’s action is scraping out the center of the hole at low speed and this is where a lot of the resistance in drilling is. As you decrease the size of the drill that flat gets smaller but it is still there. By using a starter drill you get the advantage of a little flat and a stiff body, so it does not wander. Then by using progressively larger drills to open up the hole it usually remains right where you planned.
A huge factor for success is using the right drill and it being a sharp drill. Mostly we use “twist” drills as they are so versatile. I now am much more aware of drill sharpness and actually will go through a drill set sharpening those that are dull when I have extra time, and I check each drill as I start its use. Having a drill sharpener unit has helped with that but it can only sharpen twist drills 1/16 up to about 5/8. That leaves a lot to do by the hand held methods but you can either throw it away and replace it or give it a

shot. I will admit to having over shortened some drills in the pursuit of a sharper edge. This can be a bad thing as many twist drills have a thicker webb as you grind back into the body of the drill. “Splitting” the point, or grinding to thin the webb is a very useful attribute of some drill sharpeners. About sharpeners; The sharpener is just a tool and it will only do a good job if it is used with care. There are many types but I have found the Drill Doctor to be the best compromise. It’s versatile and gives a decent edge. The best part is that it’s small and can live on the crowded bench next to the drill stands so it’s fast. No longer do I have the thought that “there are only 6 more holes, it will make it.” Now I just touch it up.

It would be very worthwhile to spend some time learning about the geometry of the twist drill. You may never have the occasion to make a special grind for a particular drilling application but having a familiarity with the standard drills will allow you troubleshoot the problem you're having.You are directed to Machinists Handbook and of course it’s all on the internet.

I have accumulated a lot of drills in part because I can resharpen and have collected handfuls of used and unsorted drills. I have also been very fortunate to have been able to buy used drill sets from shops that have been closing or friends downsizing. I even have drills my grandfather used. Then there are the specialized drills made for a particular use, shortened and lengthened are the most common but also really flat angle on the edge. And if you do woodwork there are many boring drills.

Having number drills in standard, brass dubbed, stubby and square ended, is a real luxury and for the work I do, having letter and also fractional drill sets in standard and brass dubbed, makes the work at the drill presses go much faster.

What I mean by brass, or dubbed drills are drills that present a square cutting edge to the work so they do not hog in. You can make them by grinding the sharp edge into a little flat. Also useful for drilling plastics, the coolest ones are straight flute, no twist, because a dubbed twist drill will still hog in if you become too enthusiastic at the down feed. Be sure to keep the dubbed drills separate since they will be very dull for drilling steel and just tear up wood.

Any drilled hole will benefit from being drilled in a drill press. Having the work on a surface that is square to the tool and the chuck being referenced stiffly to the table keeps erant motion to a minimum and allows you to control the down feed, hence the load on the tool. A drill press vice is a very good idea. As well as adding bulk and stability to the work, they also are useful around the shop for other purposes, they even make good door stops. By far the best drill press is a milling machine and if you have one it makes heavy drilling and large cutters much safer and reliable.

I am opposed to using gloves around machine tools as they can be a real hazard but when drilling holes in a sheet metal assembly I will wear a leather glove on my left hand. I am very careful about it, keeping to a position that will push my hand away rather than pulling it in. Sometimes it is not practical to fixture something and you have to hold it. I think it has something to do with requiring 5 stitches.
There are many types of drills and some of the specialized ones can really make you work cleaner with more accuracy. Unibits or step drills are really a great addition to the shop. With one tool you have a set of drills, they excel at thinner materials and they give very clean holes. They can drift a little but usually they will stay right there and rather than change drill bits you simply go down to the right size. I mark the right depth with a sharpie pen to simplify the depth. I recently noticed another attribute, that since these drills have a standard size shank, ¼, ⅜, ½, you don't have to change from a collet to a drill chuck to drill in the mill. That saves a setup pause. Hole saws are very useful as well. They start at ⅝” and I have seen them up to 8”. Hole saws are tricky and don’t give the cleanest holes with size wandering. They chatter and the teeth load up but to get a big hole they are expedient. You have to withdraw the tool often to clear the teeth so I like to keep a paint brush at hand to brush off the teeth. By drilling a hole on the waste side of the hole you're making you can create a chip drop point that helps keep the saw edge from loading up. Slow speed always helps, remember that the edge of the saw is traveling much faster than the small twist drills you are used to using. A job I have found holesaws extremely useful for is trepanning. This is the process of cutting out the center of a piece in the lathe. For instance making a 3” hole in a 4” round you can use

a 2 ¾ hole saw without a pilot and saw through thereby saving a piece of material, then bore to the desired size. Use a cutting fluid and clean the teeth frequently.
Speaking of cutting fluid, in metal it is always wise to use cutting fluid. Tools stay sharp longer and hole quality is improved. If you need to keep the work clean you can always use alcohol as a cutting fluid.
The best method I have found for adding cutting fluid to the work is an unbreakable tank with a good base, tall enough to hold a couple of acid brushes upright. Then you fill it with less than an inch of fluid. When the inevitable happens and you knock it over there is less waste and less to clean up.

End mills make very accurate holes. It helps to first drill out with an undersized drill to remove the heavy burden, and then redrill with the end mill. End mills are not designed as drills and have limited center cutting ability. An end mill can give an excellent on size hole with the quality of a reamer. This is the sort of thing you should test before committing to making a critical hole. You can't drill an accurate hole on an angled surface, they deflect, but you can use an endmill to spot the surface to flat to make it right.
Reamers are about hole quality and size, but if the hole is not in the right place you will have a great hole in the wrong place. Reamers just follow what is already there. There are a few issues you can fix with a reamer but miss alignments can lead to very low quality work. That said, sometimes that's good enough. Lesson is to make the best hole you can before reaming it to perfection. There is not a lot of clearance in a reamer so it is best to withdraw them and brush the debris from the flutes.
As I said, there are a multitude of specialized drill types and I have only touched on a few. Hopefully I have covered enough.
Happy boring, and wear your safety equipment.

This is a collection of some of the drills I use, intended to show the range. The twist drill sets are number (60-1) in stubby, standard, and brass dubbed. I use yellow and orange markings to separate these. Then there are fractional sets in standard and dubbed with a set of fractional reemers at the rear, and a set of dee bits. The letter drill set did not make the photo opp. Down in front there are extra long and customized just to give an idea of problem solving drills, there are many more of these modifications. The hole saws are represented and in the corner step drills. Let me draw your attention to the bottom one which was shortened to get into a firebox with a 90 degree drill motor to clean up ⅝ tube holes. “You do what you need to”

In this picture we get a closer view of “dee bits” which are great for making seats in check valves. These were commercially made but they are easy to make up as needed. The two “blacksmith” drills are 1.25” diameter. One is sharp, the other (orange) is dubbed. You can just see the little edge flat. On top of those is a set of twist drills from #61-#80. The range size in these tools is huge. Biggest twist drill I ever used was 2.5” diameter and the smallest .006”.