Part 4
Eliminating the Tools Required to Setup and The Tweaking During Startup
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Last month we examined the fifth, sixth and seventh steps in setup time reduction planning for the setup, Eliminate the Twos and Eliminate Threads Used to Setup. This month we continue this important series with eliminating the tools required to setup and eliminating the tweaking during startup.
Step 8 - Eliminating hand tools required to setup.

In article 2 I recommended installing a cabinet with all the hand tools and small change parts at the machine. By eliminating fasteners you have already eliminated 80% of the hand tools required to setup, so now, your cabinet should be fairly empty. There are probably some hand tools remaining such as special adjustment wrenches, dead blow hammers for alignment, feeler gages and tools for attachment of change parts. These tools are now prime candidates for elimination.

A few words of encouragement are in order here. Don't give up! Even if you don't eliminate every hand tool right away, some day you probably will. I had an occasion just a few weeks ago where I still had one tool on a setup at a company in California. I couldn't figure out how to eliminate this last remaining tool. I was talking to one of the machinists and shared with him my desire to eliminate the remaining tool. About two days later he came to me with an idea that indeed eliminated the hand tool. Don't be satisfied with some improvement; don't quit until every tool used to setup in your facility is eliminated!

One method that works well to reduce tools is to lay the tool and the change part that requires the tool on a table in front of a group of people. This group may include the operators, mechanics, supervision, toolmakers, and manufacturing engineers. Being able to look at the application helps to identify possible solutions. The group should determine all the possible solutions to eliminate the tool, then determine the best solution and get it implemented. You may find that the team will need multiple sessions before they will develop solutions for every tool usage. One session may not be enough. Sometimes the solution will appear to you when least expected, but in order to do that, you need to be thinking about the problem.

Many times hammers are used to tap fixtures, base plates, or other change parts into position. Most of the time they are used in conjunction with dial indicators to position them into place. Figure 4 - 1 shows one solution, which is to make what I call hard stops. This could be a precision block mounted on the machine table or on a sub plate. During setup, the fixture is pushed up against the stop and clamped into position. This eliminates the need to dial indicate the fixture and tap into position. Not only does this eliminate the tools; it greatly reduces the time spent in setup. As an alternative you could also install dowel pins to bring the fixture up against to achieve the same result. If you didn't want to mount items permanently on top of the machine table, you could mount a stop plate on

the side of the table and use spacers between the stop plate and the fixture to locate the fixture without indicating.

Whenever I observe a feeler gauge being used for position during setup, I see an opportunity to eliminate another hand tool. Gauging a part into position or to set a tool is not efficient for setup. Making a block with exact positioning may eliminate the feeler gauge.

Many times a special tool or spanner wrench is used to turn a shaft, usually for positioning during setup. Figure 4 - 2 shows where a hand wheel could be permanently installed to make the adjustment, and a position indicator is installed to provide accurate repeatability of positioning during setup. Another possibly is to eliminate the adjustment with fixed locations. Instead of adjusting, the part is moved to position and pinned, or clamped at the correct location.

Figure 4-3 shows how ball locks can be used for positioning. Figure 4-4 shows one style of quick disconnect cutting tool holders and figure 4-5 shows one style of quick disconnect chuck jaws. All of these may eliminate the use of tools during setup.

Tweaking

Reliability of the setup.

In order to understand the elimination of tweaking, you must first understand reliability and setup. If your goal is to become rapid in your setup, the you must also consider the reliability of the setup. A reliable setup means that the problems encountered during start up are eliminated. When you started your setup time reduction efforts, you probably observed a lot of tweaking after the setup during the start up of the operation. This tweaking is a demonstration that the setup is not reliable and the settings and adjustments made during setup are not sufficient to perform the operation. Now is the time to address the tweaking. Finding the cause is the first step then implementing corrective action should be straightforward. Your ultimate goal is to eliminate the artwork in your setups.

From artwork to scientific setups

I find many setup experts are also very experienced artists. By this I mean they setup the machine differently each time. Most of the time, the setup is based on material, not on standards established. You can determine if the setup is artistic by observing if the setup expert uses the material to determine settings or adjustments. This requires multiple tries in most cases to get it right. Your goal is to eliminate the use of material for setup and also to eliminate further adjustments after setup. In order to do this, the setup must be scientific. By this I mean that the settings are determined and not adjusted and that the standard settings are included in the setup procedure. On many occasions, I have watched setups where the setup expert conducted a "dry run" as part of the setup. The cause for this practice should be identified and eliminated. Dry runs are time consuming and can be eliminated. I also observe setup experts entering offsets, making a cut and

then making further adjustments to get a good part. The cause of this practice should also be identified and eliminated. All of these types of steps during setup or run are time consuming, and may be the cause of rework or scrap themselves. Many times I am told that the reason these type of steps are necessary is to eliminate scrap, rework or a crash. Being careful does not mean that we have to be slow. Again, find the cause and implement corrective action.

Produce within tolerance limitations

Far too often, the setup expert targets the tolerance limits during setup. This can cause a great deal of tweaking after the setup. The setup expert should target nominal of the specification during setup. This practice will eliminate some of the tweaking after setup. If you are utilizing statistical process control in your shop, identifying and targeting nominal should be simple to accomplish and will provide excellent results in reducing setup time and reduction in tweaking after setup.

Adjustments after setup

Many times, tweaking is required after the setup due to incorrect positioning of a fixture during setup. Your setup procedures should identify the correct positioning required during setup. If you utilize modular fixturing, the problem may be compounded by different methods used by your setup experts. Your goal should be to standardize the method and positioning of fixtures during setup, which will require that the setup experts work together to determine the best method. When using modular fixturing, an examination of your current jobs may allow you to keep certain setups on the shelf, and not tear them down. Typically a few setups account for the bulk of the jobs that are run and Pareto's Law applies here, 20% of the setups account for 80% of the jobs run. Leaving those 20% setups on the shelf may greatly reduce your setup time.

Centering the fixture is typically the best solution when fixtures are involved. Centering the part in modular fixtures is also a quick solution. As before, any tweaking after the setup indicates a need to improve the setup and the methods utilized. Don't overlook these opportunities that will help you get to rapid setups.

Speed of production

Your goal in setup time reduction is to get into production as quickly as possible, but the speed at which you start production is just as important. It is not enough to reduce the setup time, you must also get production up to efficiency as quickly as possible. When I work in companies, we set a goal that at the start of production, we run the machine just as fast as the last piece or feature is run. This is a lofty goal, but keeps everyone focused on the setup and startup speed.

Process capability results

In many shops, you have invested in Computer Numerically Controlled (CNC) machines and yet if you examine your setups, you will find they are not used properly. Originally, the purpose of Numerically Controlled (NC) and now CNC machines is to make them

quicker to change from one job to another. If you observe your setup experts entering offsets when doing a setup, question this practice and work to eliminate it. Typically an offset is entered to move the tool away from the part and leave some stock on, so a scrap part can be avoided. This practice is time consuming and wasteful both for setup and tool wear. Push your setup experts to utilize the features of the machine and discontinue this bad habit. The rule of thumb I use is if you can enter an offset and the dimension is off by the amount entered, the offset is unnecessary. If the dimension is different than the offset entered, then you need to find the cause and implement corrective action. Possibly presetting the cutting tools prior to setup is necessary.

As you can see, eliminating tools and tweaking will make your setups faster and contribute to productivity in your shop.

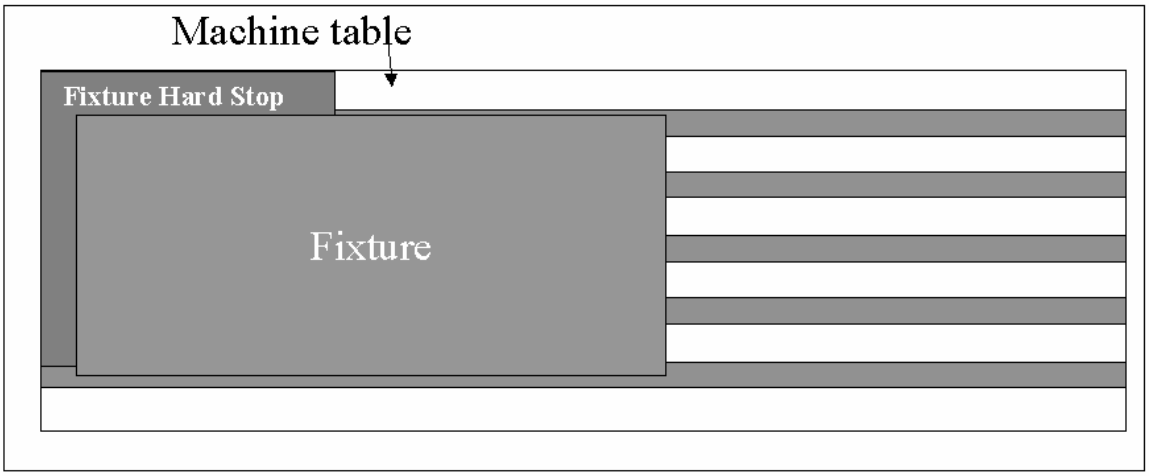

Figure 4 - 1: Fixture hard stop

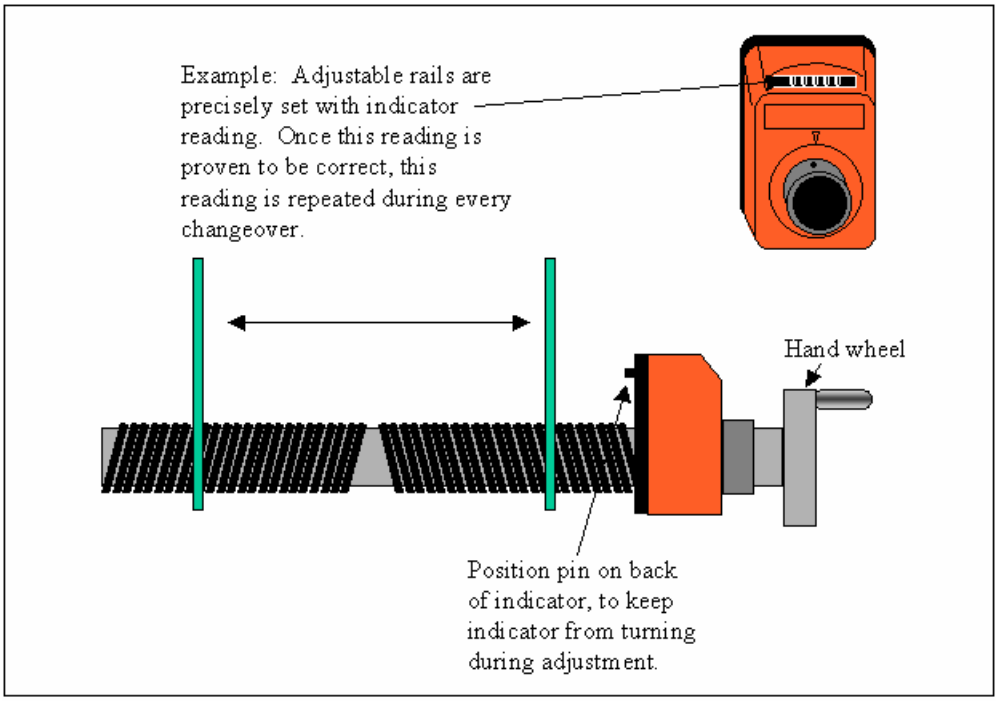

Figure 4 - 2: Position indicator for location

Figure 4 - 3: Ball locks

Figure 4-4

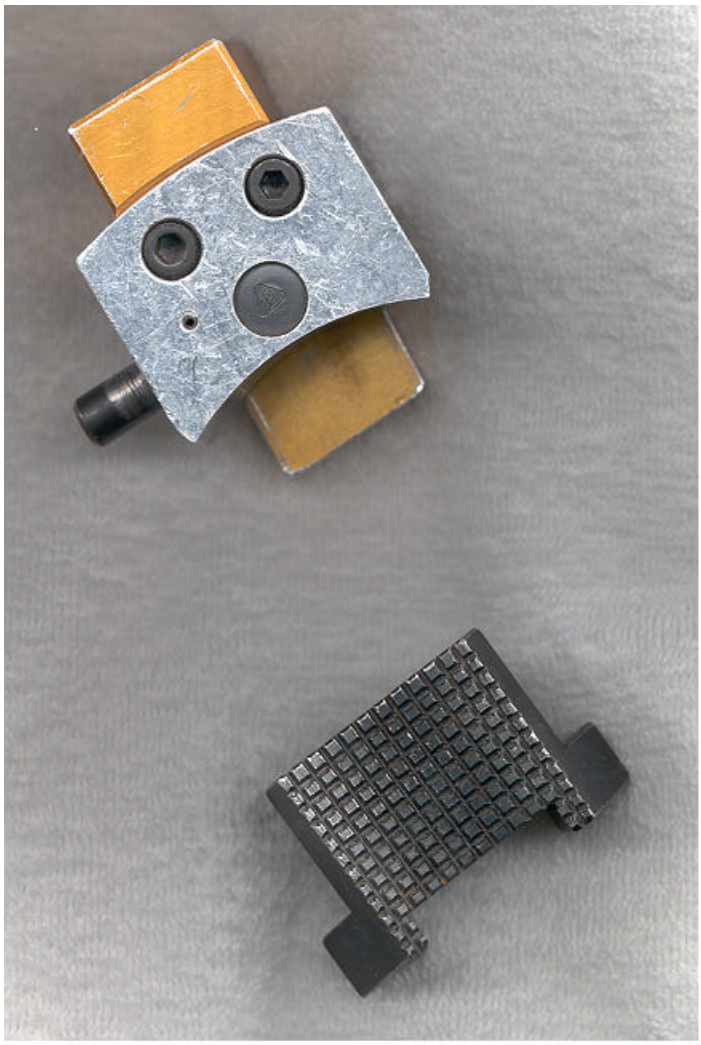

Figure 4 - 5: Quick disconnect chuck jaws