Advantages of Rolling Threads

Chipless cold forming with Landis thread rolling heads offer many advantages over other methods of producing threads.

Produce threads and related forms at high threading speeds with longer comparable tool life. Obtain threads up to 20% stronger than cut threads with significant material savings possible.

Operate at speeds higher than those obtainable with comparable thread cutting tools. With cold forming there is no abrasive wear and rolls will operate throughout their useful life without the need for periodic sizing. And the last thread produced will be as precise and as good as the first.

Cold forming results in threads of excellent micro structure, smooth mirror finish and improved grain structure for higher strength.

Rolling flows the material upward and outward to produce the thread. Because the thread is formed by the material being flowed upward and outward, the prepared blank is smaller than that required for a cut thread. This can result in material savings.

Application requirements for thread rolling are more stringent than for thread cutting. See the separate side bar on "Application Considerations".

The preceding are but some of the considerations that must be evaluated. Where thread rolling can be used it can offer many decided advantages over thread cutting.

Landis offers heads for both rolling and cutting. If you wish to consider the use of a rolling tool, but are not familiar enough with the process to make a decision, consult the factory direct, or, consult your Landis representative.

Application Considerations

1. A good rule of thumb to remember is that materials that roll well do not cut well, those that cut well do not roll well. This holds true in the majority of instances.
2. To be suitable for rolling, the material should have an elongation factor of 12%. This is the element which allows material to be plastically and permanently deformed.
3. The design and/or end use of the workpiece may dictate the use of a certain material. For example, cast iron is not a rollable material and would require that the threads be cut.
4. Cut threading allows a certain amount of latitude in respect to the O.D. of the blank. When a blank is to be cut, the nominal oversize can be trimmed away by the throat section of the die head chaser. No harm done. However, thread roll dies will accept only a specific volume of flowed material. An over-size blank results in excessive material flow which overfills the dies and results in die breakage. Therefore, the blank O.D. must be tightly controlled and held within the specified limits.

When to Roll When to Cut Threads

WHY are some threads rolled and others cut? There are a great many reasons—some valid, some not. Some threads are cut that should be rolled because they have been done this way from time immemorial. Some are rolled only because someone is partial to rolling. Still others are rolled for finish; strength; speed; material savings; chipless operation; tool position; threading back of shoulder; dimensional constancy, etc.

When should you roll threads and when should you cut threads

Threads are cut, in addition to tradition, because of depth–where more than one pass is necessary; short runs (not discounting cutting capability for long runs); the lack of necessity for blank accuracy; proximity to shoulder in end threading; where workpiece material is not adaptable for rolling; capital expenditure, where machines are being considered; many tapered threads; lack of knowledge of thread rolling; fear or aversion to new processes, etc.

Let's consider a few examples for comparison on cutting and rolling heads. We'll assume it's necessary to produce a thread on an aluminum die casting, or a piece of cast iron, or a zinc die casting or possibly one of the high-temperature space age metals. On some of these it is impossible to roll a thread–such as on the cast iron workpiece–because the metal will not flow. This is also true of some of the die castings; and the space age metals must have an opinion from the tool manufacturer as to their rollability. Chart 1 (supplied through the courtesy of American Society of Tool and Manufacturing Engineers) includes names of space age high strength, thermal resistant materials. Refer to Rollability of Material information beginning on page 50 and the Rollability Charts starting on page 62. This information concerns what can be expected in the way of material rollability and expected die life. A rule of thumb is the percentage of elongation. It shouldn't drop below 12%. This 12% figure can be misleading in the case of high work-hardening steels such as stainless, where in many cases the elongation as finished at the mill ranges from 20 to 40% and the hardness can range far below 20 Rc, but the cold forming of thread rolling will cause some grades to work-harden in the thread roots to 45 Rc and more. In cases of this kind where it is felt that the thread is too deep for a single pass it would be better to cut rather than roll, because a second pass by rolling would greatly reduce roll life.

If finish is a consideration, rolling is far superior to cutting. Some workpiece prints specify a finish on the thread, but this is in most cases, especially in fine threads (finer than 8 TPI), practically impossible to check. It should be done radially in order to get the worst condition on the flank, but the average profilometer isn't capable of a reliable check over this short distance and the tracer can't get into a 60° angle. However, generally speaking the rolled thread will be as good or better than the rolling dies, which will be 32 microinches or less, while the cut thread will rarely be better than 63 microinches. The rolled thread will be as much as 20% stronger than the cut thread. This is largely due to the unbroken grain structure, while the cut thread shears the grain at every thread form, which results in a weakened tooth (see Figure 1).

In threading from the end of the workpiece it is often necessary to roll close to a shoulder; here, the cutting head is superior. The chaser contact (the cutting edge) lies at the helix angle on the center line of the work and tangentially stops right there. The thread roll also lies at the helix angle and also contacts the work-piece on the center line, but instead of stopping at the point of contact it must continue full circle and in so doing many times can't produce a full thread close enough to the shoulder (Figure 2), because of the curve of the roll beyond the point of contact is ahead of the center line and will strike the shoulder, especially if there is a sizeable difference between the diameters of the thread and the shoulder.

On certain types of non-ferrous metals (zinc and aluminum die castings, certain types of aluminum and brass bars) cutting can be done at fairly high speeds. However, on steels - especially the higher alloys - it will be necessary to stay in the 5 to 60 SFM range. In comparison, a rolled thread can be first tried at 100 SFM and in many instances taken higher. Some jobs run as high as 400 SFM. Here a bit of caution is required because at these high speeds the axial travel is very rapid and short threads or threads going up to a shoulder are difficult to control. Where the rolling head is being used on an automatic screw machine and the threading operation does not govern the cycle time, it is foolish to do the threading at some very high speed and have the head lie idle while some other operation is being completed. 100 SFM is usually sufficient.

Where very deep, coarse, or multiple threads are to be produced cutting is best in most cases for a number of reasons. It is possible in using cutting heads to take more than one pass, without damage to the tool and to distribute the chip load over more cutting edges, thus improving finish and tool life. This is not good practice in thread rolling, as mentioned before, because any tendency to work-harden on the first pass will cause the roll to work much harder on the second. Multiple threads introduce the problem of long throats and higher pressures than single starts and must be taken into account. Roll bearing life is jeopardized and it is impossible to roll anywhere close

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When to Roll When to Cut Threads

to a shoulder. In cutting, the second pass can be adjusted so that it removes just enough metal to smooth up the thread, if it is so desired. On multiple start threads, especially Acme and Trapezoidal, where the helix angle is high and the rear flank on the chaser has a negative rake, the throat teeth can be ground individually to provide positive rake for better cutting action. With a rolling head the rolls cannot be turned to an angle great enough to accommodate many types of multiple threads.

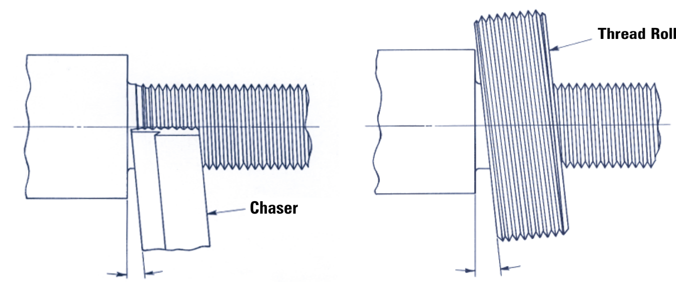
Threading behind the shoulder can be done using a straddle type thread rolling attachment. This tool operates generally from the cross slide of an automatic screw machine simultaneous with other operations being performed and is capable of rolling on the collet side of a shoulder even when the shoulder is larger than the thread. Attachments can roll very close to a shoulder, or, into a relatively small relief. They can roll either straight or taper threads and have all the advantageous characteristics of other roll threading procedures.

Although the cutting method is 100% acceptable for long runs it also requires less downtime in changeover for short runs. Also, there is a sizeable difference in the initial lower cost of the chaser as opposed to the greater cost of the roll. The workpiece for cut threads many times does not require the accuracy that a rolling blank does because the chaser can be made with a throat chamfer below the root of the thread that acts as a hollow mill to remove excess metal which the roll can't do.

Where it isn't necessary to have the full thread diameter on the workpiece back of the thread, such as bent bolts (Figure 3), etc., it is less expensive from a blank material standpoint to roll the threads. For instance, if rolling stock is purchased to blank diameter there is about a 20% savings in weight realized for 1/2-13 UNC and more than 15% for 1-8 UNC over the bar necessary for a cut thread.

Figure **1**

Figure **2**



Difference in Proximity to Shoulder

Stock containing small amounts of lead have long been used, especially on automatic screw machines, for increasing their machinability– sometimes by as much as 25%. These steels do not work out well for roll threading. The lead inclusions have a tendency to be squeezed out of the parent material as flakes and not only foul the coolant, but also cause an inferior finish. This same result occurs in high sulphur steels. Sulphur is added for the same reason as lead–increased machinability.

These are some of the reasons for cutting in some instances and rolling in others. Where a question exists as to which method is best it is best to submit the application details to Landis Threading Systems for an opinion.

Figure **3**