producingresults

The little-known life of the scarfing tool

Focusing on a small device to see the bigger picture

By W.B. "Bud" Graham, Contributing Writer

Who cares about scarfing tools? There are more important things in life. When the beauty pageant contestant is asked what problem she would like to solve, she's more likely to answer "I'd like to establish world peace" than "I wish I could find ways to help scarfing tools last longer."

Just kidding, but I'm sure you get my point. Scarfing tools are pretty boring compared to the greater issues we face since 9/11. I pray for world peace right there with anybody who will listen. But then again, I've been asked many times why tools don't last or why they break after only a short time in use. When I use the word *tools* I mean the now-ubiquitous ceramic inserts used for scarfing the OD upset seam of tube after it's welded.

I made a joke of the question, but this really is a serious topic. In my opinion, you should look at scarfing tool life as a litmus test to determine how all tools and equipment are cared for in a tube manufacturing facility. The life expectancy of a seemingly insignificant $5 to $15 scarfing insert can reveal the company's underlying attitude, pride, determination, and resourcefulness, or it can show that these are lacking. Long scarf tool life is a direct reflection of quality mill maintenance, tooling setup, slitting practices, and attention to detail. Operations with long scarfing tool life are success stories.

Before we discuss extending scarfing tool life, I should mention where scarfing tools are used. Nearly every welded tube mill employs a scarfing tool to remove the OD weld bead created by the forge-welding process (see **Figure 1**). The purpose of removing the weld bead is to leave a perfectly smooth surface; the weld zone should be visually indistinguishable from the parent material. It should be noted that some welded tube is sold *as welded*, which is not scarfed.

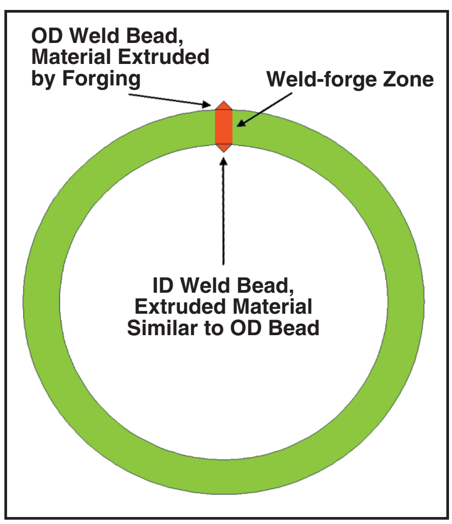

Figure 1

A typical induction-welded or electric-resistance-welded (ERW) tube has weld beads on the ID and OD. A scarfing tool can remove the OD weld bead.

Reasons for Scarfing Tool Failure

Tool life has many definitions. Whatever yours is, I'll bet you could double it and find other hidden gems by avoiding the situations in the following list, which describes many of the real reasons that inserts fail. How many of them apply to your operation?

1. Tools can and do fail because of poor manufacturing quality control, including using materials that do not meet specifications and using improper coating or grinding processes. Poor controls result in nonuniform tool performance. Do you inspect the shipment when it arrives or just put it on a shelf? Do you sacrifice quality to reduce costs?

2. Poor handling and shipping practices can affect even the highest-quality tools. Inserts are very hard and, more important, brittle. Impacts can cause the cutting surface to flake or craze, which makes the insert prone to failure. How are inserts stored and handled in your shop? Are they just thrown into a junk drawer?

3. Improper application can cause premature insert failure. Improper applications include using an insert with a holder that does not match the relief angle or using an insert that has a radius that is too small for the tube being scarfed. Do you try to cut corners by using flat inserts or radiused inserts for ODs other than intended?

4. Improperly mounting the tool or improperly applying the tool to the work can cause inserts to fail. The biggest mistake here is using the wrong hand tools to assemble, install, adjust, and engage the welded tube bead. I have seen line and supervisory personnel use hammers, prybars, bigger hammers, T-wrench persuasion (using a T-wrench to hammer, rather than tighten, a fastener), and other imaginative tools to get the job done.

Do you provide the proper tools, such as leather-faced or other types of dead-blow hammers to seat the inserts or loosen lockdown hardware? Do you supply the proper hand tools, such as wrenches and Allen keys, and new socket head cap screws for the line operators to install the scarfing tools?

The second biggest mistake is filthy operating conditions and sloppy housekeeping. Do you teach the line operators to clean tool-mounting surfaces before installing new inserts? Is your work space clean?

5. Improper operating technique can cause inserts to perform poorly. Failing to raise the scarfing tool when an end weld passes or when the line stops can in many instances cause the insert to shatter. Training and having the proper equipment are crucial. Are your personnel trained to follow the end weld through the line and open the scarf stand/ID bead rolling station, or do they allow the end weld to contact the scarfing tool?

6. Poorly designed or maintained scarf station mechanical components cut tool life. You could have purchased a poorly designed station, but if you're like the majority, you're living with an accident waiting to happen. Remember, the inserts are very hard, which is great for wear, but they also are quite brittle and do not tolerate shock loads. Toolholders (including the scarf stand components) that deflect under load or vibrate not only change the cutting angle, but also create chatter marks in the tube surface, which contribute greatly to insert failure. A 0.010-in. deflection may not seem to be excessive, but it can shorten tool life and affect tube surface quality all the way down the line.

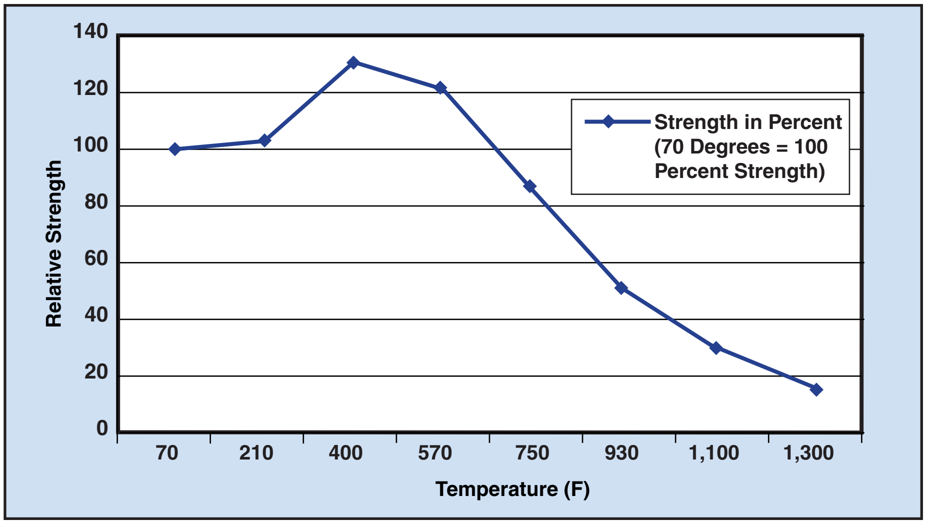

Figure 2

Temperature affects steel's strength dramatically. At 1,300 degrees F, common low-carbon steel has less than 20 percent of the strength it had at 70 degrees F.

Do you inspect and measure toolholder deflection under load with a dial indicator? Do you lubricate and repair or rebuild the mechanical components associated with the scarfing station? The scarfing station components tend to be the most ignored hardware on a welded tube mill. They are the last pieces of equipment to be maintained or replaced, despite their relatively low cost. Is this the practice at your installation?

7. Variation in incoming strip material quality, hardness changes in the coil stock, slitting burrs, and improper slit width all create varying work load conditions that find weaknesses in the mechanical structure and go directly to the weakest link, the insert.

How do you monitor material quality? This is perhaps the most difficult problem because of time constraints. "We have to run it, the customer is waiting" sums up one condition all tube manufacturers face. Replacing broken scarfing tools is a small cost of doing business but a big indicator of how well a manufacturer performs in other areas, such as good material buying, slitting setups, and quality control.

8. Buying inserts based on their cost, not their performance, can lead to disappointment. This decision comes from the top (management) and rolls downhill, creating many, if not all, of the other problems. Operators who know that a brand is supplied because it is the least expensive will work with what they get but will not buy into the process.

The Other List

And now we have a second list. The first list described the reasons for insert failure. This second list discusses some of the supposed causes of early insert failure. These are not *reasons* because they are not based on *reasoning*. Do you recognize any of them?

1. My favorites are: "It's the way we have always done it" and its brother, "If it's not broke, don't fix it." My answer to these comments is, "OK, as you say, what difference does it make that you broke a tool at every line stop and coil change?" Wait a little longer and all your customers will switch to another supplier.

2. Another favorite is switching insert suppliers based on the flavor/color/hype of the month. Inserts are a real cost of production, so don't treat them as something not worth the attention you pay to every other cost item. If you switch, do so for real, justifiable reasons. This means work! It is not easy, but the only way you will know if the "free trial" made any difference is to record the results as accurately as possible. Facts, not fictions or whims, are the only reasons you should change suppliers.

You get the picture. I have focused on a small thing to illustrate a larger picture. Where do you see yourself in this picture? Do you see something different now when you walk by the line?

The Technical Reason Scarfing Tools Break

So far we have focused on the main statement, "I wish I could find ways to help scarfing tools last longer." Now let's focus on another, related question, which is: "Why does

SCARFING TOOL LIFE CONTEST

How long do your scarfing tools last? We'd like to know. Use the formula provided here to determine the score for your scarfing tool (one of the cutting surfaces of a carbide or ceramic insert) and get industrywide recognition for your production team. We'll announce the winner in the September issue of *TPJ–The Tube & Pipe Journal*® and we'll send each member of the winning tube mill crew a TPA coffee mug. Entries must be postmarked no later than Monday, June 30.

Check List

❏ This entry form, completed, signed, and postmarked no later than Monday, June 30, 2003.

❏ Photograph of crew

Send your entry to Bud Graham, Welded Tube Pros LLC, 16574 Old Chippewa Trail, Doylestown, OH 44230.

Entry Form

Company Name ____________________

Street Address ____________________

City, State/Province, Country ____________________

Name of Company Representative ____________________

Signature of Company Representative ____________________

Phone Number ____________________

Fax Number ____________________

E-mail Address ____________________

Total Number of Hours of Operation ____________________

Average Line Speed (feet per minute) ____________________

Wall Thickness* (inches) ____________________

Score (Hours × Speed × Wall Thickness) ____________________

If more than one wall thickness is produced, estimate the percent of time the tool was used on each gauge.

All entries must include the following:

1. A photo of the production team standing in front of the weld or scarf station along with permission to use the photo in *TPJ–The Tube & Pipe Journal*® (we'll provide a permission form to the winning company after determining the winner).

2. The entry form completed, signed, and submitted no later than Monday, June 30, 2003.

Formula: Hours of operation × line speed × wall thickness = tool life score

Examples:

• 4 hours × 0.060-in. tube × 250 feet per minute = 4 × 250 × 0.060 = 60

• 4 hours × 0.100-in. tube × 250 feet per minute = 4 × 250 × 0.100 = 100

Tool life is calculated by multiplying the total number of hours of operation by the average line speed (measured in feet per minute) by the wall thickness (measured in inches). If more than one wall thickness is produced, estimate the percent of time the tool was used on each gauge. The tool life score reflects the workload and awards a higher score for heavier-wall tube than for thin-wall tube manufactured under the same conditions.

The target to beat is 2.5 hours at 275 feet per minute on tube with a 0.065-in. wall for a score of 2.5 × 275 × 0.065 = 40.2.

Steel Color vs. Temperature

Color	Temperature C	Temperature F
White	1,200	2,192
Light Yellow	1,100	2,012
Yellow	1,050	1,922
Light Orange	980	1,796
Orange	930	1,706
Light Red	870	1,598
Light Cherry	810	1,490
Cherry	760	1,400
Dark Cherry	700	1,292
Blood Red	650	1,202
Brown Red	600	1,112

The steel should be viewed in a dark or faintly lighted room and must not be exposed to direct light. The color chart should be viewed in normal diffused daylight and not in direct sunlight or artificial light.

Shear Strength at Room Temperature (70 Degrees F)	Average Temperature (Degrees F)	Shear Strength Percent (Compared to Strength at 70 degrees F)	Load on Insert (Pounds)	Stress on Tool Face (Pounds)
60,000 PSI	1,200	20	276	12,000
60,000 PSI	400	132	1,822	79,200

This table is based on a pyramid-shaped scarfing tool that measures 0.187 in. (width) by 0.125 in. (height) and has a section area of 0.023 sq. in.

Figure 3

To find the stress on the tool face, multiply the shear strength at room temperature by the shear strength percentage that corresponds to the average temperature at the weld point. To find the load on the insert, multiply the stress on the tool face by the insert's section area (in this case, 0.023 sq. in.).

the insert break if I don't lift it out of the cut position when the line stops or when weld power shuts down?" The answer is temperature change. After the weld power is shut off, weld seam and scarf strand average temperatures drop rapidly. This temperature drop leads to a dramatic increase in weld bead strength (see **Figure 2**). This graph is applicable to most common low-carbon steels.

The increase in bead strength causes an abrupt increase in the load on the scarfing tool, which causes it to break.

The baseline, which is used for comparison with other temperatures, is the material's strength at 70 degrees F. Because a typical weld-forge temperature is 1,800 to 2,200 degrees F, the resulting weld upset material's strength is only a small percent of its strength at room temperature, or 70 degrees F. When the weld upset temperature drops from 1,200 to 400 degrees F, the material's strength increases from 20 percent to 132 percent of its baseline strength (strength at 70 degrees F). When the weld power shuts down, the material's temperature drops immediately and its strength increases abruptly, which increases the load on the scarfing tool and causes it to break (see **Figure 3**).

So now you know! The material's strength broke the tool, but in an unexpected way.

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If you have a specific question or would like to see an article on a particular problem, please contact the author or TPJ.