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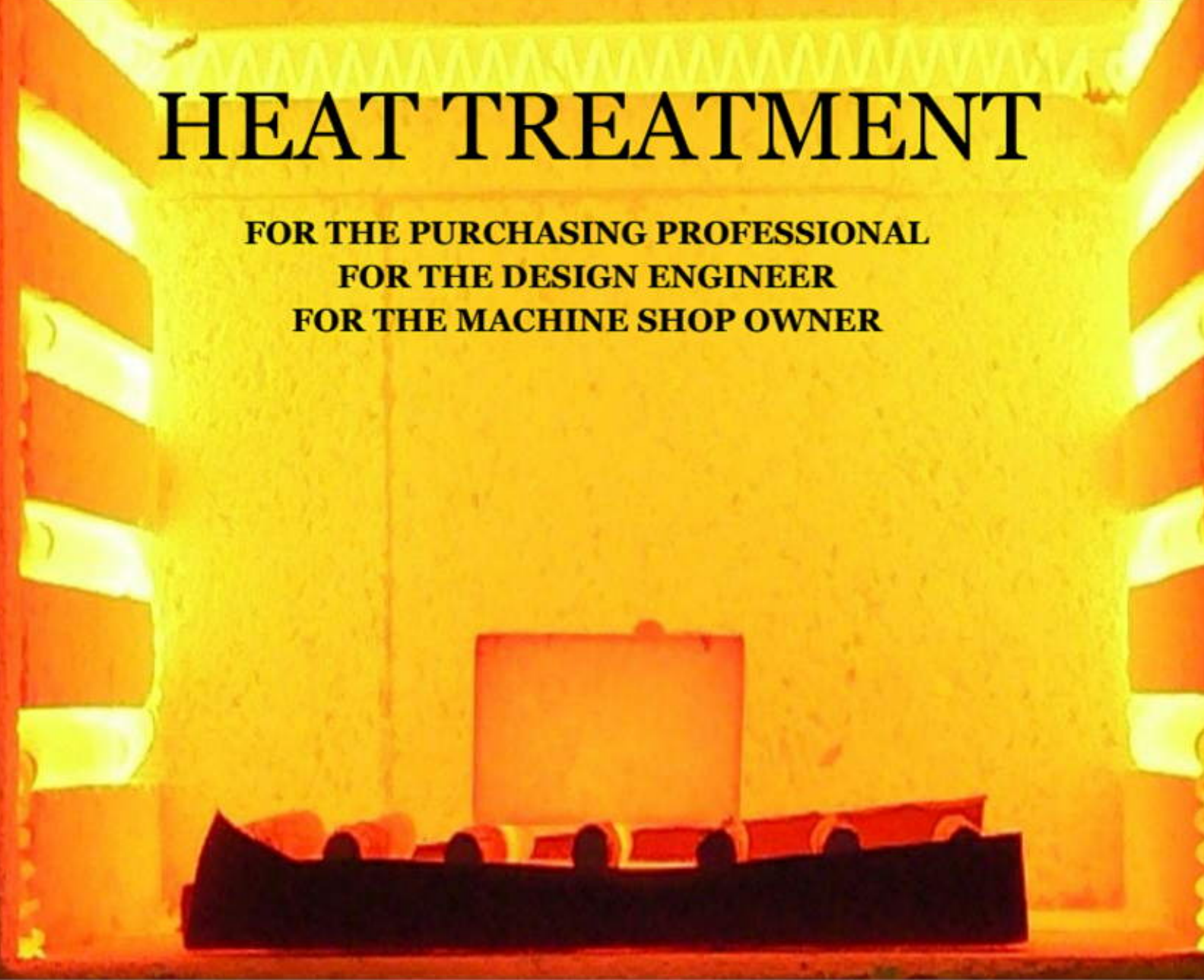
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A GATEWAY EDUCATIONAL ENLIGHTENMENT ARTICLE

Subject: HEAT TREATMENT

. FOR THE PURCHASING PROFESSIONAL
. FOR ENGINEERING PROFESSIONALS
. FOR MACHINE SHOP PROFESSIONALS

This article isn't written to just educate buyers and engineers about the importance of the heat treat process. Our point is to enlighten readers on all levels on how to get better, more controlled heat treatment. Ultimately, how to get better tools and products for their company's use. We want to awaken readers that even a spot-on hardness reading's results on a heat treated product is far from a sign of great grain structure. In fact, just the opposite can be true.

Heat Treating isn't just another service, and it's a bit more difficult to determine if it was done correctly. Yes, it is a service, but it is a very critical service that either makes a great tool, or potentially a piece of junk. It is not a service that should be purchased blindly, or taken lightly. There are critical areas that a good buyer, or engineer, should know. It goes far beyond how much it costs per pound to get the process done, and done right.

And right up front you need to understand a part that doesn't perform well is not likely caused by the heat treater. They are nearly always scratching their head wondering why an engineer specified another peculiar hardness level for a given grade of steel. They obviously don't have the time to stop and ask why that hardness was requested. They are not the designer. They are a very important service provider and they produce what they are requested to produce. The grain structure inside that tool or heat treated part may, under examination, look and resemble a total piece of trash. But they performed the process to meet your purchase order request!



Harold Snow, Snow's Heat Treatment measures hardness to verify he is meeting the purchase order requested specification.

Well, you say, I'm not worried. I only need a Rockwell hardness of 58-61Rc. The structure should be fine if we get that! WRONG, Wrong, wrong. Hardness has near zero relationship to the grain structure. It is a measurement of hardness. That's all it is! It's a reference measurement. A well heat treated metal, or a piece of junk, can

Continued on page 7



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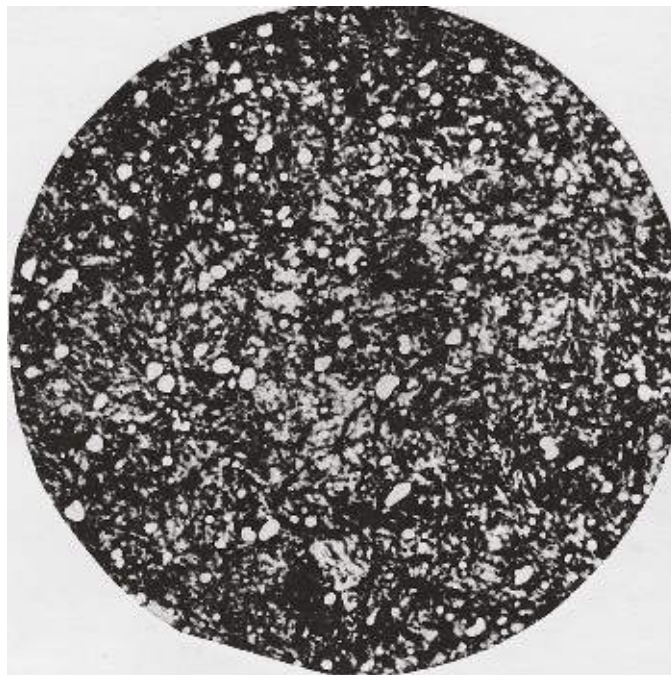
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have a perfect, text-book hardness. The only way to tell the good from the poor heat treated part is to examine the interior structure of the part. The micro structure is what should be the key to judge a good heat treated metal. **The hardness is not going to tell you anything about how a metal will wear, take impact, or survive! NOTHING!!!!**

So does that means we need to destroy the part to examine the structure? But then the part is no longer of any value!

No, what you can do, is create a sacrificial specimen from the same bar of steel the part came from with equal sizing to the finished part. In other words, if the final finished part is to be 1" thick x 3" wide x 4" long, then the specimen should also measure 1" wide x 1" thick x 1.25 to 2" long. Care always needs to be taken concerning which way the part or the specimen is cut from bar stock. Heat treated steel grows longer than it does across the bar which is caused by the mill's steel rolling process. This growth may affect critical hole or other features locations. If the part is tube shaped, the thickness of the wall will be used to determine the thickness of the specimen. The specimen should be stamped with the part number and the grade of steel. Then request the heat treater to treat the specimen(s) right along with the actual parts being processed, and to supply a chart recording from the furnace process. The chart recording will reveal the time and temperature record. In some cases you can even wire the specimen to a part. In addition, if the sacrificial part is carefully ground, record the exact length and width measurements.

It may also be useful if the sacrificial part is stamped to identify the length of the original stock. That will establish the growth characteristics as steel always grows during heat treatment. Steel grows longer with the length than it does in width because the molecular structure is effected by the rolling process. And no, steel does not ever shrink during proper heat treat. Shrinkage indicates the steel was over heated. But by doing this sacrificial sampling with the times and temperatures used by



This is an example of a piece of D2 tool steel that has been properly heat treated at 1850^oF +/-5o, air quenched to between 100^oF-150^oF, double tempered at 960^oF for the first draw for 2 hours per inch, then drawn the second time at 900^oF again for 2 hours per inch.

Drawing the steel is used to refine the grain structure and to stabilize the fresh martensite crystal structure. Martensite is the fine grains in the structure. This piece contains 18% retained austenite (larger grain outlines seen in the structure. Easier to see in the lab.)

The white globular grains which are nicely dispersed in the photo are the carbides that contribute to the greater wear resistance that D2 is known for in the cold working, air hardening tool steel grades.

Magnification: 1000X

the heat treater, you can establish the best heat treat recipe for that grade and size of steel. Once you establish this basic information you can purchase or indicate the exact heat treating process you want performed on your parts and request the strip chart recording to verify it was carried out to your specifications.

Please understand, heat treating is really a

Continued on page 9



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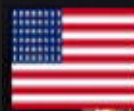
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very exact, precise science! Every grade of metal requires a specific Time, a specific Temperature to obtain the best possible Transformation in the grain structure. This TTT formulae requires extremely precise Timing, often within seconds at each step of the process. The Temperature is also often precise in a very narrow zone in some grades of metal heating and cooling. And that leads to the third area which is the Transformation of an annealed (un-hardened) metal into a hardened structure with very fine grain structure that exhibits great dispersion of its elements.

We want to implant an understanding of what a buyer should look for in a heat treat service provider. That's very hard to do because conditions change in the course of each day in an active heat treat shop. Be mindful that heat treaters, who have been around for decades, and in

-house captive heat treaters often have very minimal actual heat treat education. Most of it comes from on-the-job training and can be great, or not so much. Having conducted hundreds and hundreds of heat treat seminars all over the USA and Canada for decades, we only found one in thousands of engineers and heat treaters, just one, who had the basics down right. Mind you most had decent knowledge, but had developed their own habits over time.

The purpose of this article is to get your company to think of how they can get a better bang for their buck. If I had my way, I'd like to see an engineering specification document for purchasing to use that contains the exact steps of how the engineer wants each grade of metal heat treated, step by step. It should include the correct temperatures, soak rates and time per inch of

Continued on page 11



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thickness, complete tempering temperatures and times with expected hardness results. This would give purchasing the complete specification information to get the job done correctly.

Purchasing deserves that information, especially on critical components and frankly heat treaters, whether commercial or in-house, want it as well. Will this affect the cost or time to get the work processed? Yes, it likely will, but remember, no worthwhile job should be performed incorrectly. The life of the part may be at stake, but so could human life be affected by a sloppy process.

Look at it this way. Engineering can spend a lot of hours designing the perfect part. The shop can spend an additional amount of time machining the parts. Then the heat treater, whether in house, or commercial, is very often under the gun time wise to get the parts processed in just a couple hours along with potentially pressure from a hundred other customers or production needs. The life and quality of a part is often a last minute rush that leaves the quality of the finished part hanging in the balance of a 2-3 hour process, most often with little direction, and possibly incorrect hardness dictates.

Let's take a minute on this incorrect hardness dialogue. There are several hardness scales used to measure hardness values. We'll just look at Rc which is Rockwell C scale. Most carbon based steels can be heat treated, and by using various tempering temperatures hardness is lowered. Historically, steel producers brought various grades of steel on the market originally and primarily to meet a particular customer or project requirement. The chemistry was developed to fill the need for wear, or impact resistance, or toughness, or heat or compression. Some grades may offer more than one attribute, but most were developed to handle just one attribute well.

The long list of steel grades were basically developed to meet those needs at the optimum hardness of the chemistry. But the mills identified that by tempering each grade, the tensile and yield strength of each grade changed if a lower hardness was called out. Then in the mid-1900s the chemistry of steels gradually exploded with greater

Important Fact: Every heat treated steel has an optimum operating hardness the steel was originally developed to excel at. Drawing hardness down to increase toughness may completely ruin the steel's real value.

and greater chemistry to offer far, far more variations of those original five characteristics. Metallurgists found they could air harden some steels and eliminate the harsher water and oil quenching to get hardness. However it was mostly misunderstood that they were really meant to be used at their potential hardness. What took place was engineers loved some of the characteristics of some steels they used, but they wanted less brittleness, less chance of breakage or failure, they could simply specify a lower hardness tempering, instead of choosing the correct steel grade. It is a natural tendency and might save a few cents by not carrying just another grade or two. Management also didn't want another grade of steel in their inventory so the engineer was not able to specify what he knew was correct. So it was a catch-22 scenario. What it does, is the heat treaters inherited the mess. They heat treated the steel at its optimum temperature, and optimum time, to get the optimum hardness from the grades design. But then they are forced to temper the parts to draw hardness out. Along the way, many never knew to stay away from danger zones, like the 500⁰F to 800⁰F where hydrogen embrittlement becomes a factor. So often, this adjustment works against the Engineer, and ultimately the company. Using the wrong grade of steel, then killing the intended usage often ends up making inferior parts. Far from steels potential or just enough to get by.

Please don't think we are against engineers in this scenario! Just the opposite. Engineers are the backbone of manufacturing in the USA. And so are our machinists, our purchasing professionals and our heat treaters. Our desire is to see the right grade of material used first, then heat treated properly to create the best possible product. I've preached to tens of thousands of engineers and heat treaters over more than half a decade,

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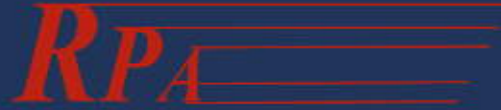
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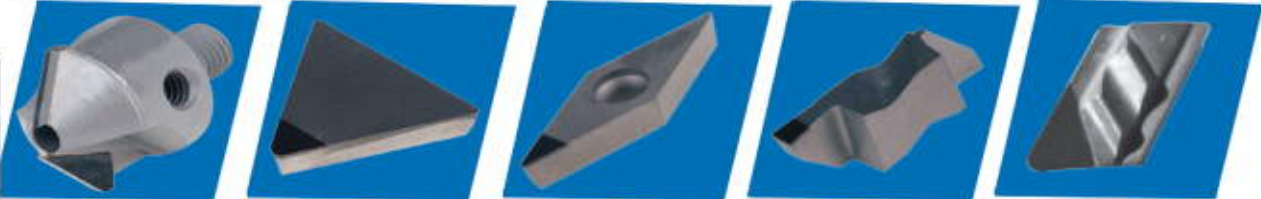
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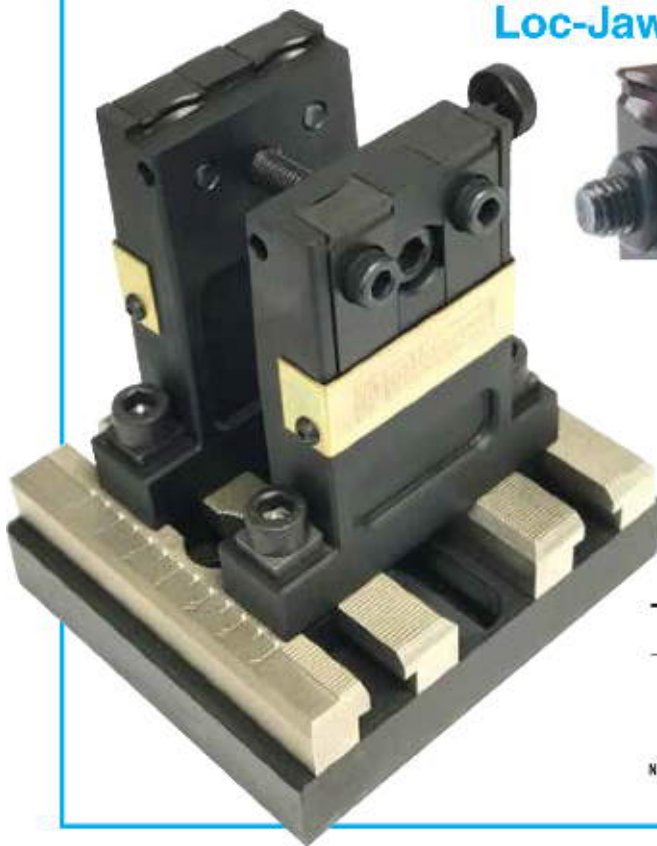
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PRESS RELEASE

Loc-Jaw® Combo-Edge Gripper

NEW!



MITEE-BITE is pleased to announce a new feature to our Loc-Jaw® System - the **Combo-Edge Gripper**. This efficient redesign incorporates both knife and blunt edges in one grip.

Previously the Loc-Jaw® System shipped with four Knife-Edge and four Blunt Edge Grippers. Now the System will ship with four Combo-Edge Grippers installed, allowing the user more versatility with a simple *flip of the grip!* Choose the penetrating knife edge for holding raw stock or the blunt edge, with our new tungsten carbide coating, for high speed machining on hard alloys.

Part No.	Description
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Replacement Parts

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14503	Loc-Jaw® Support Bolt #3 (M10 x 90mm)
14504	Loc-Jaw® Support Bolt #4 (M10 x 110mm)
14508	Loc-Jaw® Combo-Edge Grippers - 1 side knife edge, 1 side blunt edge with carbide coating (2 per pack)
14518	Loc-Jaw® Jaw Set - Includes 2 Jaws, 4 Combo-Edge Grippers & Screws

Torque (Ft/lbs)	Holding Force (lbs)
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15	3,000
20	4,000
25	5,000
30	6,000

NOTE: Blunt Edge side is recommended for alloys above 35Rc



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PRESS RELEASE

New England Electropolishing was recently awarded 2017 Supplier of the Year by East Bay Manufacturing, Bristol RI. NEE provides Electropolishing and Passivation services on East Bay's precision machined parts. Factors such as quality, on time delivery, and customer service were considered by the parts supplier when evaluating potential candidates.



From Left to Right (Luke Almeida VP Business Development, NEE, Erica Bert QA Manager, NEE, Lauri Desrosiers Office Manager, NEE, Randy Medina, GM, East Bay Mfg., Imad Jaber, OPS Manager NEE, Amy Prigmore, VP Finance, NEE)

Randy Medina, General Manager of East Bay Manufacturers said the following of working with NEE, "New England Electropolishing has been a valued vendor for us year in and year out. Their quality and on time delivery speaks for itself. With a blend of warmth and professionalism from the top down, they have a way of making you feel like you're the only customer they have."

NEE Management celebrated the award by giving all employees gift cards to a local Food Store. "This award speaks to the dedication of the entire team at NEE. Many people from order entry, processing, inspection, and shipping ensure that customer satisfaction is met and exceeded on a daily basis" said Luke Almeida, VP Business Development.

New England Electropolishing provides Electropolishing and Passivation services to parts' manufacturers servicing the Medical, Aerospace, Semiconductor, and precision machining industries. East Bay Manufacturing provides design and manufacturing services for many industries with a focus on precision machining. To contact New England Electropolishing:



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PRESS RELEASE



Dapra Marking Systems Introduces Flexible, State-of-the-Art Fiber Laser Part Marking Solutions

From turnkey Class 1 workstations with safety enclosures to open-style Class 4 configurations and fully integrated solutions, Dapra Marking Systems has introduced a new series of laser offerings designed for maximum performance and easy customization.

Dapra Marking Systems made a significant investment in product development to engineer a series of fiber laser part marking solutions from the ground up, pulling from a stable of state-of-the-art components to create a flexible core product line that can be quickly tailored to a customer's individual application requirements.

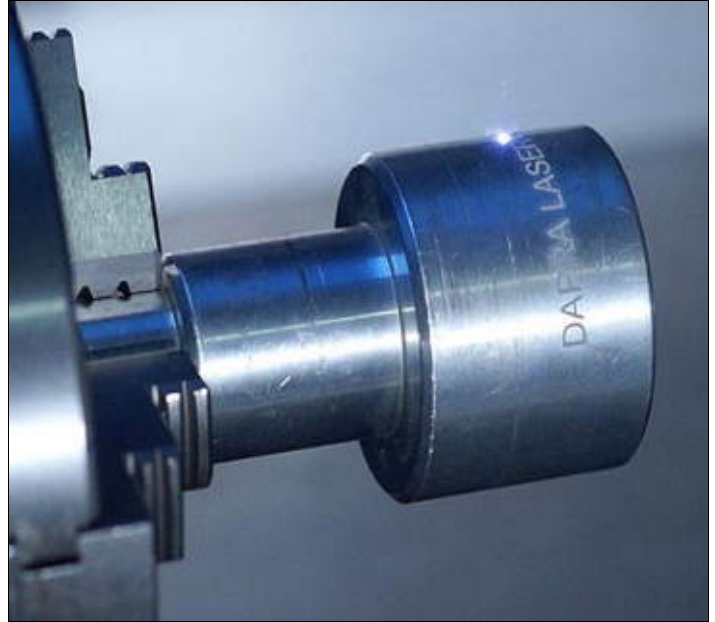
"Our approach is very much application driven," said David Noonan, Dapra's Director of Laser Marking Sales and Applications. "Customers shouldn't have to force their needs into an existing box because that's all that's available to them. Our core systems are very easy to customize, on a very cost-effective level.

"We talk to each customer and help them determine what system configuration, laser source, lens, power source and accessories will be the best fit for their application, and we create a solution tailored to their needs."

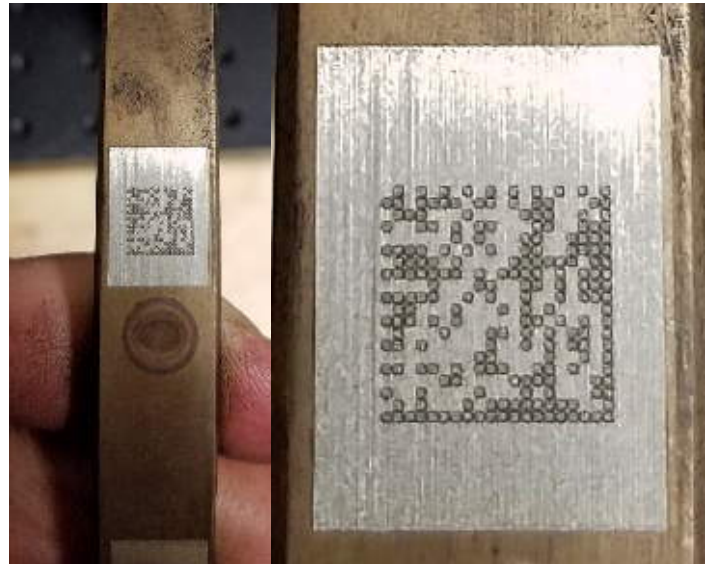
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