SECOND QUARTER 2025 | VOLUME 32

SPRAYTIME

INTERNATIONAL THERMAL SPRAY ASSOCIATION

AWS

ITSA Scholarship Recipients

Machining Thermal Spray Coatings

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Published by the International Thermal Spray Association, a Standing Committee of the American Welding Society

Mission: To be the flagship thermal spray industry publication providing company, event, personnel, product, research, and membership news of interest to industrial leaders, engineers, researchers, scholars, policymakers, and the public thermal spray community.

SPRAYTIME®
Publisher *Annette Alonso* / **Editor** *Cindy Weihl*
Editorial Staff *Kristin Campbell, Roline Pascal, Alexandra Quiñones*
Technical Editor *Daniel Hayden*
Design and Production *Carlos Guzman, Zaida Chavez*
Advertising *Scott Beller, Lea Owen*

SPRAYTIME® (ISSN 1532-9585 Print) (ISSN 2689-0518 Online) is a quarterly publication of the International Thermal Spray Association. Printed on recycled paper.

Article submissions (subject to acceptance and editing), advertising insertions, address correspondence, subscription requests, back issue copies, and changes of address should be sent to:

American Welding Society
Attn: *SPRAYTIME*
8669 NW 36 St., #130, Miami, FL 33166-6672
(800/305) 443-9353 | *spraytime.org*

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Kirk Fick
Chair

Dear ITSA members and colleagues,

I'm happy to report that ITSA had a strong presence at the AMPP Annual Meeting in Nashville, Tenn., where we hosted a booth that drew consistent traffic throughout the show. We gathered a solid list of leads from those interested in thermal spray services and ITSA membership. A special thank you to Alina Blanco at AMPP for providing the booth, as well as ITSA Vice Chair Ashley Hunsaker and ITSA Program Manager Adrian Bustillo for helping plan and representing ITSA so well at the booth!

As a reminder, the deadline for the 2025 ITSA Scholarship is August 30, and it'll be here before you know it. If you know someone pursuing a graduate degree in thermal spray or a related field, please encourage them to apply. It's a great opportunity to support the next generation of leaders in our industry.

We're excited to announce that the 2025 ITSA Annual Meeting and Symposium will take place November 10–12 at the Peoria Marriott Pere Marquette in Peoria, Ill. This year's event is presented in partnership with AMPP, highlighting our ongoing collaboration to advance thermal spray technologies across key industries.

Our technical program will spotlight applications in mining, agriculture, and overhaul/repair areas where surface engineering continues to deliver real value. Expect insightful presentations, case studies, and practical research that speak directly to the needs and innovations in these sectors.

We're also pleased to offer a tour of the Caterpillar production facility, giving attendees a unique behind-the-scenes look at how coatings support modern manufacturing in heavy equipment.

I hope to see many of you in Peoria this fall as we come together to share knowledge and advance our industry.

Lastly, don't forget that submitting articles or updates for *SPRAYTIME* consideration is free and a great way to promote your work or company. We're seeking content for:

- Q3 (September) – Thermal Spray in Aerospace
- Q4 (December) – Thermal Spray Powders

Submissions are due two months before publication. For details, please contact Cindy Weihl (*cweihl@aws.org*).

ITSA MISSION STATEMENT

The International Thermal Spray Association (ITSA), a standing committee of the American Welding Society, is a professional industrial organization dedicated to expanding the use of thermal spray technologies for the benefit of industry and society. ITSA invites all interested companies to talk with our officers and company representatives to better understand member benefits.

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ITSA SCHOLARSHIP OPPORTUNITIES

ITSA offers annual graduate scholarships. Since 1992, the ITSA scholarship program has contributed to the growth of the thermal spray community, especially in the development of new technologists and engineers. ITSA is very proud of this education partnership and encourages all eligible participants to apply. Visit *thermalspray.org* for criteria information and a printable application form.

ITSA *SPRAYTIME*

Since 1992, ITSA has been publishing *SPRAYTIME* for the thermal spray industry. The mission is to be the flagship thermal spray industry publication providing company, event, personnel, product, research, and membership news of interest to the thermal spray community.

JOIN ITSA

Membership is open to companies involved in all facets of the industry — equipment and materials suppliers, job shops, in-house facilities, educational institutions, industry consultants, and others.

Engage with dozens of like-minded industry professionals at the Annual ITSA Membership Meeting, where there's ample time for business and personal discussions. Learn about industry advancements through the one-day technical program, participate in the half-day business meeting, and enjoy your peers in a relaxed atmosphere complete with fun social events.

Build awareness of your company and its products and services through valuable promotional opportunities: a listing in *SPRAYTIME*, exposure on the ITSA website, and recognition at industry trade shows.

Plus, ITSA Membership comes with an AWS Supporting Company Membership and up to five AWS Individual Memberships to give to your best employees, colleagues, or customers. Visit *aws.org/membership/supportingcompany* for a complete listing of additional AWS benefits. For more information, contact Adrian Bustillo at (786) 937-9595 or *abustillo@aws.org*.

For an ITSA Membership application, visit the membership section at *thermalspray.org*.

NOW ACCEPTING
SCHOLARSHIP APPLICATIONS

Since 1991, ITSA has supported technologists and engineers by offering scholarships for postgraduate studies in thermal spray processes (plasma, flame, arc, HVOF) or materials science at accredited universities across the United States.

Up to three (3) scholarships

$2,000 each

Application Deadline: **October 30, 2025**

For more eligibility information or to apply, visit thermalspray.org/scholarship

Attend the ITSA 2025 Annual Meeting

The International Thermal Spray Association (ITSA) will hold its 2025 Annual Meeting at the Peoria Marriott Pere Marquette in Peoria, Ill., from November 10 to 12 in conjunction with the Association for Materials Protection and Performance (AMPP).

The Annual Meeting is a must-attend for thermal spray industry professionals, offering the opportunity to connect with peers and discover the impact of thermal spray technologies in heavy machinery, overhaul, and mining. This two-and-a-half-day event includes the AWS C2 Committee on Thermal Spraying and ITSA executive committee meetings and a tour of Caterpillar's tractor assembly plant and the Visitors Center. A formal ITSA business meeting will also be held. Additional information about this event will become available in the coming months. Updates on the 2025 Annual Meeting will be posted at *thermalspray.org*.

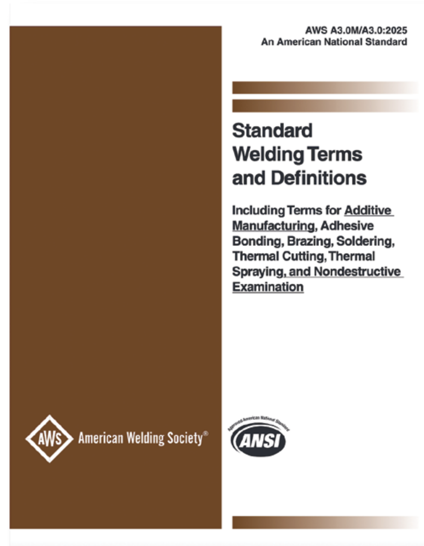
Apply for a $2000 ITSA Scholarship

Applications for the International Thermal Spray Association's (ITSA's) Scholarship Program will be accepted until October 30. Up to three one-year scholarships worth $2000 each may be awarded. Since 1991, the ITSA Scholarship Program has contributed to the growth of the thermal spray community, especially the development of new technologists and engineers.

To be considered, applicants must meet all the following criteria:

- Be actively pursuing a postgraduate degree in thermal spray processes (plasma, flame, arc, high-velocity oxygen fuel) or materials at an accredited U.S. university,
- Have at least one year of studies remaining after this year,
- Be recommended by a supervisor/professor of the university they are attending (a professor must verify the student's financial need, and the student must also be recommended by at least one industrial source), and
- Present an essay about their interest in pursuing a career in thermal spray (maximum of three typed pages).

The application can be accessed at *aws.org/about/industry-partners/itsa/ITSA-Scholarship*. Winners will be announced in the fall.



The updated AWS A3.0M/A3.0:2025 features a glossary of technical terms used in the welding industry, including revised terms and definitions for the thermal spray industry.

New AWS A3.0 Standard Features Thermal Spray Terms and Definitions

AWS, Miami, Fla., has recently released A3.0M/A3.0:2025, *Standard Welding Terms and Definitions Including Terms for Additive Manufacturing, Adhesive Bonding, Brazing, Soldering, Thermal Cutting, Thermal Spraying, and Nondestructive Examination*. This American National Standard is available through the AWS Bookstore at *pubs.aws.org*.

This edition represents an update to the 2020 version. It features a glossary of technical terms used in the welding industry, including thermal spray (see next section), to establish standard terms to aid in communicating information related to welding and allied processes.

"Using accurate welding terminology is critical," said Stephen Borrero, secretary to the AWS A2 Committee on Definitions and Symbols. "Clear and consistent definitions ensure professionals can communicate effectively and avoid costly mistakes. A misinterpreted term in a welding procedure, inspection report, or blueprint can create safety hazards, cause project delays, and result in expensive errors."

Since it is intended to be a comprehensive compilation of welding terminology, nonstandard terms used in the welding industry are also included. All terms are either standard or nonstandard. They are arranged in word-by-word alphabetical sequence.

AWS A3.0M/A3.0:2025 includes the following updated terms and definitions for the thermal spray industry:

- **Thermal spray pass.** A single progression of the thermal spraying torch across the substrate surface.
- **Thermal sprayer.** One who performs manual or semiautomatic thermal spraying. Variations of this term are arc sprayer, flame sprayer, and plasma sprayer.
- **Thermal spraying torch.** A device for heating, feeding, and directing the flow of surfacing material.

Alleima to Develop Thermal Spray Products

Alleima, Sandviken, Sweden, a global manufacturer of advanced stainless steel, specialty alloys, and industrial heaters, is investing in thermal spray technology to develop new products in sustainable energy. The company has sent the first prototype of the coated material to a customer.

"This investment is part of the company's long-term strategy to drive innovation and create sustainable solutions," said Tom Eriksson, head of strategic research at Alleima. "It is a pilot that will primarily be used for research purposes but will also be used for small-scale production when possible. By using this technology in our manufacturing processes, we can offer advanced materials and components that meet the high demands of hydrogen production. This initially includes the development of components for electrolyzer cells but

Alleima announces a research initiative exploring thermal spray technology for manufacturing electrolyzer components used in green hydrogen production.

also other applications that require robust and durable coatings."

The technology will eventually allow the development of products that replace expensive material solutions. This will help reduce the cost of electrolyzer stacks, which in turn can promote the increased use of green hydrogen and thus reduce carbon emissions.

Titomic Unites with DNV for Global Certification

Titomic Ltd., an Australian provider of 3D metal printing and cold spray technology, is collaborating with DNV, a risk management company in Oslo, Norway, to obtain certifications for its advanced coating and repair technologies in the oil and gas and maritime sectors.

The collaboration aims to achieve qualification under NORSOK M-501, *Surface preparation and protective coating*, a global standard developed by the Norwegian petroleum industry for offshore installations. This certification will validate the Titomic Kinetic Fusion™ cold spray additive manufacturing technology for high-performance, corrosion-resistant applications in harsh marine and offshore environments.

"This agreement with DNV marks a significant step forward for Titomic as we expand into the global energy and maritime markets," Klaas Rozema, president of Titomic EMEA, said. "NORSOK M-501 and related maritime certifications will enable Titomic Kinetic Fusion™ to be recognized for thermal spray aluminum repairs; surface protection of field welds; and restoration of marine hulls, ballast tanks, subsea infrastructure, and pipeline systems. Working with DNV ensures our technology is held to the highest international standards."

HC Starck Joins the Mitsubishi Materials Group

Mitsubishi Materials Europe BV, Amsterdam, Netherlands, a subsidiary of the Mitsubishi Materials Corp. Group (MMC), has completed its acquisition of HC Starck Holding GmbH (HC Starck Group), Goslar, Germany.

The acquisition includes HC Starck Tungsten GmbH, which operates production facilities in Germany, Canada, and China, as well as sales offices in the United States, China, and Japan. The deal also covers Chemilytics GmbH & Co. KG and Chemitas GmbH, which operate at the Metallurgie Park Oker in Goslar.

MMC, a manufacturer of metal-based high-performance materials, operates its tungsten recovery facility in Japan and has long sourced tungsten-based products from HC Starck. The acquisition supports the company's continued focus on recycling and raw material sustainability.

"The change of ownership opens up new, promising perspectives for the strategic development of our group," Hady Seyeda, CEO of the HC Starck Group, said. "On the one hand, our recycling capabilities harmonize perfectly with MMC's stated goal of focusing on particularly sustainable activities. On the other hand, forward integration into MMC's metal processing value chains promises significant synergies."

AZZ Announces Leadership Changes at Precoat Metals

AZZ Inc., Fort Worth, Tex., an independent provider of hot dip galvanizing and coil-coating solutions, has appointed Jeff Vellines as president and chief operating officer (COO) of its Precoat Metals business segment. Kurt Russell, who previously held the position, will transition to the role of senior vice president and chief strategic officer.

Vellines joined Precoat Metals in 2011 as director of strategic planning, leading the integration of Roll Coater. He was promoted to vice president of sales in 2013 and later to senior vice president, overseeing all commercial operations. He became president of AZZ Precoat Metals in early 2024. His prior experience includes leadership roles at Roll Coater and Material Sciences Corp.

"We are excited to have Kurt Russell, with his tremendous experience in the metal coatings industry and successful track record leading AZZ Precoat Metals, move into the newly created chief strategic officer role," said Tom Ferguson, CEO of AZZ. He added that Vellines will assume Russell's responsibilities as COO.

2025

Coatings Science International Conference
June 30–July 3
Noordwijk, The Netherlands
coatings-science.com

AMPP LatinCORR + Panamerican Corrosion Conference
July 17, 18
Panama City, Panama
ampp.org/events/latincorr-panamerican-corrosion-conference

AMPP Central Conference
September 8–10
Odessa, TX
ampp.org/events/central-conference

IMAT 2025
October 20–23
Detroit, MI
asminternational.org/imat-2025

ITSA Annnual Meeting & Symposium
November 10–12
Peoria, IL
thermalspray.org

Symposium on Emerging Materials and Innovation in Thermal Spray
December 1–3
Melbourne, Australia
asminternational.org/semi-2025

2026

AMPP Annual Conference + Expo
March 15–19
Houston, TX
ace.ampp.org/home

International Thermal Spray Conference and Exposition (ITSC 2026)
March 18–20
Bangkok, Thailand
asminternational.org

American Coatings Show + Conference
May 5–7
Indianapolis, IN
american-coatings-show.com

BY DANIEL C. HAYDEN

MACHINING THERMAL SPRAY COATINGS

Thermal spray coatings can provide wear and corrosion resistance and can quickly build up dimensions on metallic components that have been worn down or mismachined. They're fast, affordable, and effective, and they are way off the radar of many of the engineers and machinists who might use them. The result is that, despite this technology's flexibility and utility, there aren't many prints out there that call for thermal spray coatings. And, when they do, manufacturers, programmers, engineers, and machinists seldom know how to work with them. Thermal spray coatings are functional and highly effective when used properly. But, to the uninitiated, they can be brittle, tough, flaky, and frustrating to work with.

This article intends to shed some light onto the nature of these materials and how to handle them when they're being machined. Depending on the application, thermal sprayed materials are used as is, in their as-applied condition, or they are required to be finished to a specific dimension and/or surface finish. When finishing is required, grinding is often preferable because coating materials are often hard and respond well to the slow material removal rate typical of a grinding operation. Grinding is the only finishing option for very hard metallic coatings, tungsten carbide composite coatings, and ceramics.

Most metallic thermal sprayed coatings can be tooled if the proper care is taken, and this alternative may be attractive for reasons such as speed, price, and portability of the tooling process. Since tooling is a more technique-sensitive finishing method, we'll focus on the fundamentals of tooling thermal sprayed coatings.

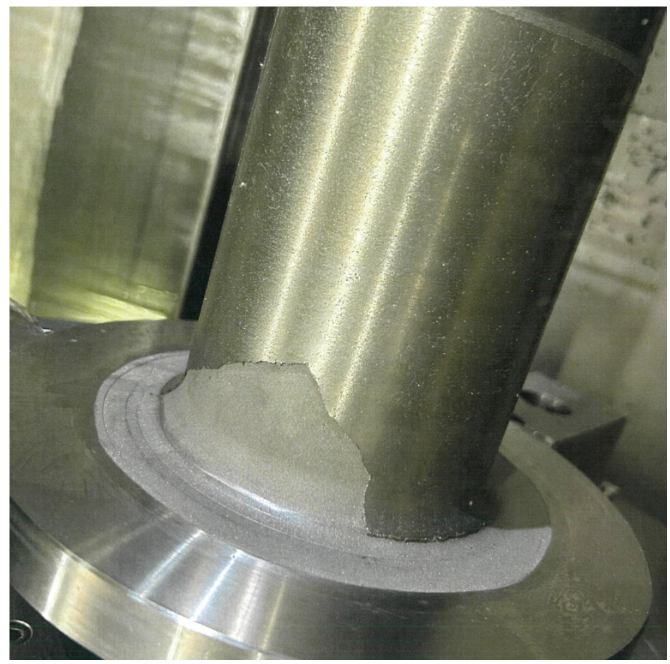


Fig. 1 — The coating lifted and failed where it was wrapped around a radius.

Preparation

It is important for the machinist to understand that thermal sprayed coatings are not wrought materials, and they won't tool like them. First, the bonding mechanism is mechanical, not ionic or covalent. The structure is like a tightly packed and very hard sandcastle. Particles of coating lock into the particles around them using high heat and pressure, and the strength of the bond is dependent upon the intricacy of the interlocking joint and the yield strength of the sprayed material. What's more, as the coating is built thicker, often the tensile stresses within the coating will accumulate, fighting against the mechanical forces holding the coating in place, and reinforcing the coating's tendency to pop. In compression, even heavy, high-shrink materials might continue to perform. But, with the application of an additional mechanical stress in opposition to the bonding mechanism, failure at the bondline and within the coating is highly likely.

A further aggravation to this already sensitive system is the presence of features within the coated geometry that could lead to an uneven distribution of stresses within the coating. When a coating is wrapped over a sharp corner or peak, as it cools, more of the coating's internal stresses will accumulate over that feature — Fig. 1. Less effort will be required to initiate a failure at that point than at another less-irregular region of the coating.

Areas where the coating integrity is compromised also produce failure-prone regions with the coating system. A common example is a coating applied to an undercut region, such as the outside diameter of a shaft, where a damaged area has been repaired with thermal spray. If the undercut is prepared with straight sides, then soot, fines, and other impurities can become trapped in the sharp relief, making the coating in that area more porous and less well bonded than the adjacent coating structure. Since this phenomenon

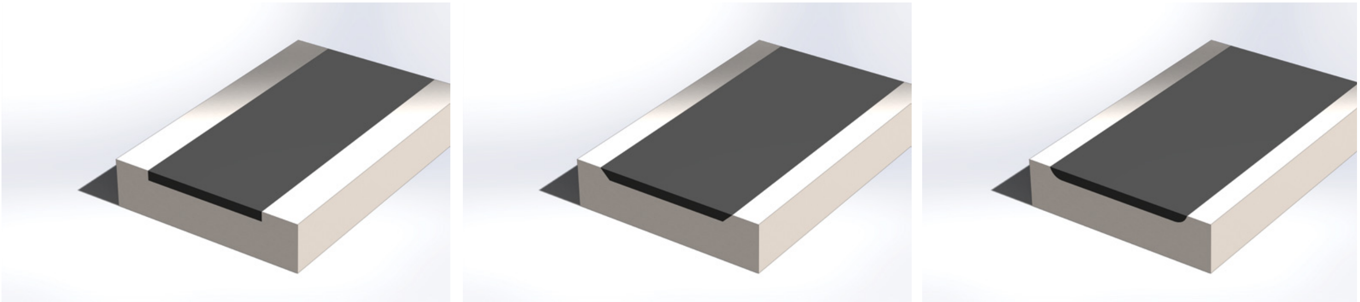


Fig. 2 — Sides of undercut pockets for coating should not be vertical (left) but should be chamfered (center) or radiused (right).

occurs at the edge of the coating, a failure here will allow the rest of the coated area to be attacked from the side, interfering directly with the bondline and, more likely than not, leading to catastrophic coating failure.

For these reasons, it is best to ensure that thermal sprayed coatings are never applied over potential stress risers, that coating geometries do not tend to leave coated areas exposed to potential attack from impact or gouging stresses, and that, when the coating is applied within a prepared undercut pocket (often the best practice), the pocket is prepared with chamfered or radiused borders — Fig. 2.

Following these basic guidelines will ensure that the coating performs well and withstands only the abuse for which it was designed. The most common reason thermal spray coatings are tooled, rather than ground, is that the application must be done in the field, and tooling equipment is more portable than grinding. Thermal spray is well suited to repairing damage and bringing failed equipment back online in short order because the coating can be applied and finished in the field. Spun bearings and failed seals are good examples. The resulting damage is typically on a mission-critical diameter that is now undersized and possibly irregular. For the equipment to return to service, the diameter must be cleaned up, restored to size, and brought to a suitable finish. A uniform buildup on cylindrical work is easy to achieve because the consistent surface speed required for thermal spray coating can be achieved by rotating the shaft and slowly traversing the spray gun. The coating can then be tooled with a portable lathe and brought to finish with emery, sometimes without removing the piece from its service location.

Materials

Materials for repair must have performance characteristics at least equivalent to the original base material. They must also be relatively easy to machine because rework will only exacerbate downtime. Stainless steels in the 300 and 400 series are readily available in powder and wire. Whether plasma, flame, or arc sprayed, they can usually be tooled, and some respond well to being built to fairly heavy thicknesses without risk of failure.

In addition to their flexibility for a variety of applications, these materials also tend to be hard and durable, a good fit for the repair of rotating equipment that has seen significant material loss. Another attractive feature of these materials is the ease with which a quality repair can be made using arc spray. Since this spray process has few utility requirements, only power and compressed air, it is often a simple matter to get the hardware in place to do a repair in the field, even under less than favorable conditions. High-bonding alloys like nickel aluminide, aluminum bronze, and molybdenum also make great repair and salvage materials, depending on the application. Like the steels, they can nearly universally be built to significant thickness without risk of failure and can be tooled, rather than ground. Though some of these materials are softer than steel, this may not be a concern, for example, in corrosive environments, where wear is less a concern than chemical attack or galling.

Applications

Following are some generic application categories where coatings are commonly applied and then machined to dimension for repair purposes. The selection is designed to illustrate commonly successful types of repairs rather than unusual or exotic applications.

As mentioned previously, journal and bearing area repair is common because of the depth and breadth of rotating equipment in service. In nearly any instance where a machine component includes a spinning shaft, that shaft will be supported by some kind of bearing, and that bearing is protected by some kind of lubrication system. When the lubrication system fails, if the machine continues to operate, the deterioration of the shaft beneath the bearing can be quick and significant. To repair an area where a bearing has seized or spun, the area must usually be excavated to restore the diameter to some uniform dimension. Again, it is important to make the undercut with chamfered sides.

Depending on the thickness of the coating required to restore dimension, either a high-building steel or a bond coat with steel top coat will likely be used. A tight fit with a close tolerance is usually required for bearing areas, and, while this usually requires grinding between centers, a field repair can be brought into approximate finish by tooling and then polishing with emery tape.

Military standard procedures for the repair and overhaul of marine equipment have been in place for decades. While becoming qualified to perform these repairs for government agencies can be time consuming and difficult, the procedures demonstrate the usefulness of corrosion-resistant thermal sprayed materials for the salvage of mission-critical equipment in hard-wearing and corrosive environments.

In typical applications, the material applied for repair or rework is similar to the base material, e.g., aluminum bronze or nickel aluminum for naval bronze castings, Monel™ or nickel copper for nickel-based alloys, and austenitic steels for carbon and low-alloy stainless steels. For pump housings and impellers, valves, hatches, and other components that come in contact with seawater, effective cleaning prior to coating is essential. Oxides remaining on the surface prior to coating can negatively impact bond strength and cause the coating to delaminate under lower stress. Depending on the geometry and the nature of the repair, either hand spray or automation can be used. Most materials used in these applications are easily tooled, so the accuracy of the spray application is less critical than for many other jobs. Hand blending, including die grinding and sanding, can be used to effect many repairs.

A large percentage of commonly applied roll coatings are used as surface enhancements. Traction coatings are often applied and used in their as-sprayed condition. Hard coatings used to extend the life of roll surfaces are typically ground, rather than tooled. The chief exception is restoration of dimension. When diameter is critical, and a roll has been ground or reground and is now under the minimum serviceable diameter, its life can be extended almost limitlessly by rebuilding the surface and then tooling it back to size. This can be especially valuable for the salvage of rolls that have suffered minor damage, such as gouges or dings — Fig. 3.

Twin-arc-sprayed 400-series stainless steel is often compatible, in terms of chemistry and coefficient of thermal expansion, with most roll shells. It can be applied quickly and built to significant thickness, and it is easily tooled to a decent finish. Gouges and other inconsistencies in the surface are often best treated by machining the entire circumference undersize in the affected zone until the damage has been eliminated and then blasting and rebuilding. Alternately, coating the entire roll face and then tooling to smooth can be used to clear up multiple small blemishes and/or restore cylindricity.

As with spun bearings, sealing or packing areas on rotating shafts often develop circumferential wear patterns that can be significantly under the original shaft diameter. Unlike bearing fits, deterioration in these zones can happen far more slowly and with less obvious consequences. Nonetheless, proper functioning of a seal or packing is essential to the proper operation of valve stems and pump shafts, and restoration of the lost dimension will eliminate leaking and restore the sealing integrity of the coupling. Materials used for the repair of sealing and packing areas must typically be hard enough to withstand the constant sliding wear of the active seal but must also be free from porosity, incomplete bonds, cracks, or other discontinuities that can lead to premature deterioration of the sealing or packing material. Nickel-chromium alloys are particularly well suited to the repair of wet-service components in sealing applications. The alloys are largely corrosion resistant and wear very well but also tend to exhibit good homogeneity; there are no hard carbide particles, choppy oxides, or excessive porosity that can tear into and abrade sealing components. They also can be tooled and polished fairly easily.

Fig. 3 — Common repair and enhancement of the packing area on pump sleeves.

Tooling Fundamentals

Tooling thermal sprayed coatings is not overly complex, so long as it is understood that the material cannot be treated as if it is solid or wrought. Understanding that there are limits to the bond strength of the coating and that tooling forces must be controlled to remain clear of these limits is the fundamental challenge. Largely, the practice of taking light cuts with a sharp tool at lower-than-usual surface speeds will translate to success in machining sprayed coatings. Erring on the side of caution is also helpful. Some more specific practices are as follows:

Avoid attempting to machine any applied material with a nominal hardness in excess of 55 HRC. Many thermal sprayed coatings, particularly those discussed previously, fall well below this limit, but attempting to tool a harder material, or overworking a work-hardening material, will lead to excessive tool wear; poor cut quality; and probably cracking, failure of the overlay, and frustration.

Be sure to mount tools rigidly, with the tool holder as close as possible to the cutting point. Any possibility of vibration or deflection of the tool that might compromise the quality of the cut will lead to premature tool wear and the headaches that follow.

Keep tools sharp. Once a tool begins to wear, the friction imparted will begin to heat the coating, eventually leading to rubbing and blistering of the coating. At the first sign of anything other than an easy, consistent cut, replace or rotate the insert and continue the cut. Use a smaller infeed or slower traverse if an uninterrupted cut is essential. A sharp pointed tool, such as a threading insert or grooving tool, will typically wear too quickly, and some amount of radius (0.0156 to 0.125 in.) will help extend the effective tool life. In general, though, the tool radius should be as small as can be tolerated for the finish required. A larger nose radius will lead to a wider cut with more surface area in contact with the tool, which will increase the risk of overheating the coating.

Table 1 — Feed Rates and Spindle Speeds for Commonly Sprayed Metals

20 to 35 HRC coating hardness	30–60 ft/min, 0.050 in. depth of cut, 0.005 in. infeed per spindle revolution
35 to 50 HRC coating hardness	20–50 ft/min, 0.020 in. depth of cut, 0.002 in. infeed per spindle revolution
50 to 55 HRC coating hardness	10–30 ft/min, 0.010 in. depth of cut, 0.005 in. infeed per spindle revolution
> 55 HRC coating hardness	Grind, do not tool

Across the board, harder inserts are better. Although the material being tooled may not be hard in its typical form, thermal spraying can often lead to the development of oxides within the coating structure. These hard formations can be aggressively damaging to low-grade tools, and higher quality, harder inserts will tend to perform better longer. Tungsten carbide is a de facto choice. Cubic boron nitride and diamond tools have been used, but the additional cost is typically unnecessary.

Feeds and Speeds

Zero degrees of rake (vertical tool pitch) is a safe position for machining most sprayed coatings. Negative rake (down angle) will just lead to dragging and loading, and the coating will quickly fail. Positive rake is possible, but only to a limited degree and only on fine cuts, as there is a significant risk of gouging the coating or catching an area of incomplete bond and lifting the material away, resulting in catastrophic failure. Bear in mind that once a tool has gotten beneath a coating, the coating will lift off, like when paint is scraped.

In general, harder materials will require slower feeds and speeds to cut effectively. You'll quickly know that you're moving too fast when the tool either snaps or grinds away. Provided the inserts are sharp and you are taking care to proceed gently with the cutting effort, some combination of feeds and speeds will cut nearly any metallic commonly sprayed. Table 1 provides a good rule of thumb for most coatings.

The following list has some common traps both inexperienced and experienced machinists fall into when tooling coatings.

Fig. 4 — The insert began cutting freely (bottom) but got progressively more dull, eventually overheating and blistering the coating

- Not keeping the inserts sharp or not replacing inserts often enough — Fig. 4. This can allow the tool to plow or burnish the coating rather than cut it. When this excess heat is imposed, the coating may blister and fail.
- Attempting to make an interrupted cut in a coated zone, such as a keyway, may lead to the coating chipping at the far side of the interruption. It is preferable not to tool an interrupted coating, but, if you must, consider filling the gap with a carbon or brass insert.
- Attempting to cut too quickly will dull the tool, leading to the aforementioned plowing and blistering.
- Failing to keep the tool cool can cause some coating materials to work harden, which can quickly make a material uncuttable.
- As with any coating, there are risks of taking too much material off and breaking through in one or more areas, which will introduce a failure-prone zone in the coating. Carefully addressing runout prior to machining should ensure that the coating thickness is consistent on all sides.
- On the other side of the same coin, the spray technician must be sure to apply enough coating so that the machinist can restore the required dimension without leaving a low spot where the tool fails to take a chip.

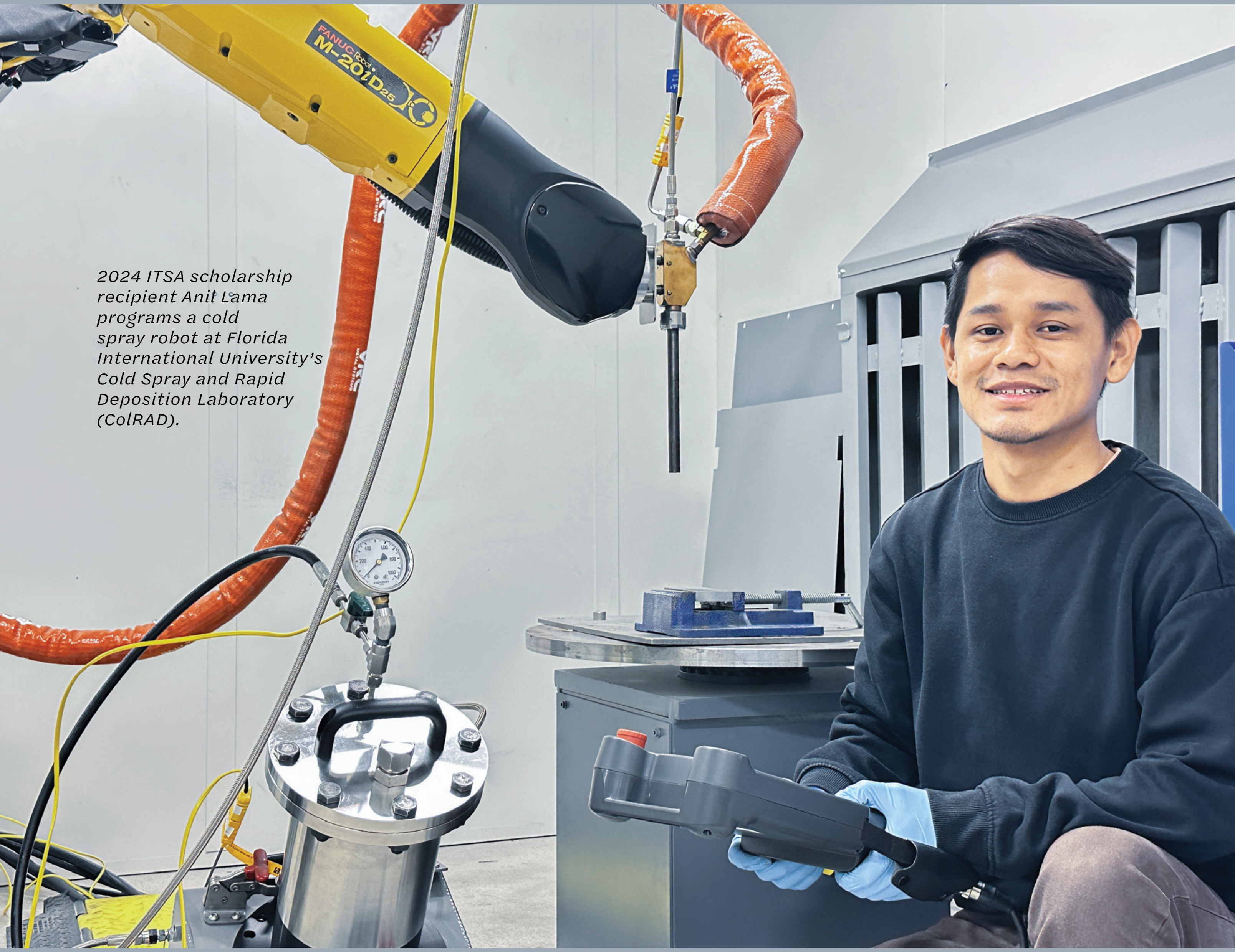
Working carefully and taking light cuts will help you avoid nearly all of these mistakes. Again, it is most helpful to remain aware that the material being cut is a coating on top of the original piece and not an integral part of the component. Approaching the tooling of a coated surface as if it were a thin, hard shell on a mandrel, which to some extent it is, should guide a machinist to make smarter choices about tool selection and feeds and speeds. From a practical standpoint, the much lower stock-removal rates characteristic of a grinding or lapping process might make this a better option than tooling when the option is available. Grinding also offers an improved range of surface finishes and the ability to cut very hard materials like tungsten carbide and ceramic coatings by using superabrasive grinding wheels. Grinding thermal spray coatings also has its own set of peculiarities, but this is a topic for another time.

DANIEL C. HAYDEN *(daniel.hayden@haydencorp.com)* is president, Hayden Corp., West Springfield, Mass., chair of the AWS C2 Committee on Thermal Spray, and technical editor of *SPRAYTIME.*

This article was originally published in the September 2011 Welding Journal.

BY CINDY WEIHL

2024 ITSA Scholarship Recipient BRIDGES SCIENCE AND INNOVATION



2024 ITSA scholarship recipient Anit Lama programs a cold spray robot at Florida International University's Cold Spray and Rapid Deposition Laboratory (ColRAD).

Anil Lama is pursuing a PhD in materials science and engineering at Florida International University (FIU), Miami, Fla., and will graduate this fall. With a strong passion for surface engineering and a deep-seated interest in thermal spray technologies, particularly cold spray, Lama's academic and professional trajectory has been shaped by a desire to bridge advanced scientific research with impactful, real-world applications. His commitment to pushing the frontiers of cold spray technology is evident through his scholarly work, mentorship, and recognition within the materials science community. For these reasons, he was selected as one of three 2024 ITSA Scholarship recipients.

Discovering Cold Spray

Lama was drawn to thermal spray, especially cold spray, because of its unique ability to merge advanced materials science with real-world engineering applications.

"The world of thermal spray technology, particularly cold spray, has become a cornerstone of my academic and professional journey. My initial fascination began during my master's studies at the Skolkovo Institute of Science and Technology, Moscow, Russia, where I took a course on thermal spray coatings. That foundational experience opened the door to a deeper exploration of the field, which has since grown into a focused academic and research-driven passion," said Lama.

Joining the Cold Spray and Rapid Deposition Laboratory (ColRAD) at FIU further cemented his commitment.

"My decision to pursue doctoral studies was a deliberate one. I wanted to contribute to the scientific advancement of surface engineering, with a particular emphasis on cold spray technology. This field offers immense potential to solve pressing real-world problems, and I am driven to push the boundaries of our understanding and capabilities," he explained.

Recognition through the ITSA Scholarship

Since receiving the ITSA scholarship, Lama's research has continued to evolve. He is focused on the development of cold-sprayed coatings for applications ranging from structural integrity and radiation shielding to wear resistance. His work has led him to present at prestigious conferences such as TMS2025 and IMECE2024 and author several research manuscripts. He has also mentored undergraduate students on senior design projects, providing guidance in technical planning and experimental design.

"One of the most affirming moments of my academic path was being awarded the ITSA scholarship. This recognition was more than financial support — it was a profound validation of my work and aspirations. It provided the freedom to focus fully on my studies and experimental work without the burden of financial stress. More importantly, it connected me to a vibrant professional community of researchers and practitioners who share a passion for innovation in thermal spray technologies," he shared.

Forging Future Paths

Looking ahead, Lama envisions a career as a leader in advanced materials research either in the industry or at a national laboratory. He is especially interested in roles within the aerospace and defense sectors, where he believes thermal spray technologies can deliver a transformative impact. He's also open to academic roles that combine teaching and research, as he finds fulfillment in mentorship and knowledge-sharing.

For other students considering a path in thermal spray, Lama encourages them to pursue their dreams and not shy away from any challenges they may encounter.

"Seek out research experiences, pursue internships, and find mentors who can guide you. The learning curve is steep, but the rewards are worth it. The thermal spray community is supportive, and the field is rich with opportunities to innovate and make a meaningful difference," he said.

2025 Scholarship Applications Now Open

Lama was one of three outstanding students awarded a 2024 ITSA scholarship, recognizing their academic excellence and innovative research in the thermal spray field. The two other recipients were Proches Nolasco Mkawe from Binghampton University, Binghampton, N.Y.; and Tyler Kleinsasser from South Dakota School of Mines &Technology, Rapid City, S.Dak. The ITSA scholarship committee is now accepting applications for 2025. Visit page 6 of this issue of *SPRAYTIME* for more information on how to apply.

CINDY WEIHL (*cweihl@aws.org*) is editor of *SPRAYTIME*.

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Thermal Spray Coatings Market on a Growth Path to $18.25 Billion

Thermal Spray Coatings Market Size, Share and Growth Forecast for 2024–2031 reports the market is projected to witness significant growth in the coming years, driven by the increasing demand across diverse industries, including automotive, aerospace, energy, and manufacturing. The market was valued at approximately $12.09 billion as of 2024 and is expected to reach $18.25 billion by 2031, a steady compound annual growth rate of 6.1% from 2024 to 2031. Thermal spray coatings are gaining widespread acceptance due to their ability to improve durability, wear resistance, and corrosion resistance. The market is supported by several key factors, including the growing industrial applications of thermal spray coatings, advancements in technology, and increased investments in industries requiring high-performance materials. The automotive and aerospace industries are the largest consumers of thermal spray coatings, as these sectors demand coatings that can withstand extreme conditions and provide enhanced performance. Additionally, the growing trend toward eco-friendly and cost-effective surface treatments is boosting the adoption of these coatings in various industries. Geographically, the North American region holds the largest market share, followed by Europe, owing to the robust industrial base and high demand for advanced coating solutions in these regions.

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Powder Coatings Market Expected to Rise at 5.9% CAGR by 2032

According to *Global Powder Coatings Market*, the market size was valued at $14.5 billion in 2023 and is poised to grow from $15.36 billion in 2024 to $24.29 billion by 2032, a compound annual growth rate (CAGR) of 5.9% during the 2025–2032 forecast period. The powder coatings market is witnessing notable growth, backed by factors like durability and performance and technological advances. Powder coatings provide high durability, aesthetic appeal, and corrosion resistance, fueling market demand. Moreover, improvements and innovations in technology, such as application techniques and enhanced color options, are notably impacting market growth. However, the market is hindered by application limitations, since these coatings may not be suitable for all types of substrates, and heavy market competition by liquid coatings, which have wider applications. The report illustrates market opportunity by region and segments. Production and consumption patterns are carefully compared to forecast the market. Other factors considered are the growth of the adjacent market, revenue growth of the key market vendors, scenario-based analysis, and market segment growth. Market size was determined through a top-down and bottom-up approach, which was further validated with industry interviews. To determine growth, factors such as drivers, trends, restraints, and opportunities were identified, and the impact of these factors was analyzed. The market's continued growth will be driven by evolving consumer preferences and ongoing innovations.

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Thermal Spray Market Expected to Grow at a CAGR of 7.2% from 2024 to 2031

The global thermal spray market is expected to grow at a compound annual growth rate (CAGR) of 7.2% during the 2024–2031 forecast period, according to *Thermal Spray Market Size, Share, Industry, Forecast and Outlook (2024–2031)*. The report provides in-depth insights and analysis on key market trends, growth opportunities, and emerging challenges. Through a combination of qualitative and quantitative research methods, it offers comprehensive reports to help companies navigate complex market landscapes, drive strategic growth, and seize new opportunities in an ever-evolving global market. Various industry-affecting factors are examined, including governmental regulations, market conditions, competitive levels, historical data, market situation, technological advancements, upcoming developments in related businesses, market volatility, prospects, potential barriers, and challenges. The regional analysis of the market covers key regions such as North America, Europe, Asia-Pacific, Middle East & Africa, and South America.

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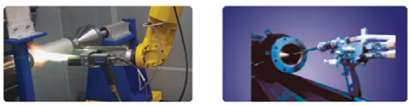

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