FOURTH QUARTER 2022 I VOLUME 29

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INTERNATIONAL THERMAL SPRAY ASSOCIATION

Low Pressure Cold Spray

Thermal Spray Art

ADVANCED THERMAL SPRAY SYSTEM

PLASMA SPRAY SYSTEM

MASS FLOW CONTROLLED PLASMA SPRAY SYSTEM
Model - AP-2700

AP-2700 FEATURES :-

- Data logging.
- Recipe selection.
- Remote diagnostics.
- Slave / master / manual modes.
- Meet Requirement of Industry 4.0.
- Touch screen mass flow controlled.
- 80kw Standard, 120kw Optional Power Capacity.

MASS FLOW VIEW PLASMA SPRAY SYSTEM
Model - MPS-80

MPS-80 FEATURES :-

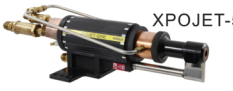
- "CE" Approved.
- PLC Controlled.
- Auto & Manual Modes.
- Support 2 Powder Feeder Operation.
- Can Be Integrated With Chiller, Door, External Interlock.

HIGH VELOCITY OXY FUEL SPRAY SYSTEM

Model - AK-2700

AK-2700 FEATURES :-

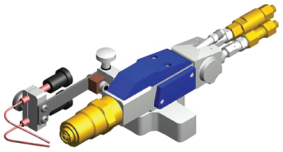
- Data logging.
- Recipe selection.
- Remote diagnostics.
- Slave / master / manual modes.
- Meet Requirement of Industry 4.0.
- Touch screen mass flow controlled.


XPOJET-5250

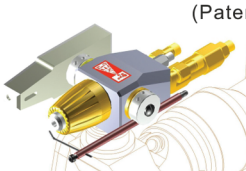

XPOJET-5000


MJP-6000

FLAME SPRAY SYSTEM


POWDERJET-86 A

CERAJET GUN
(Patent Applied)



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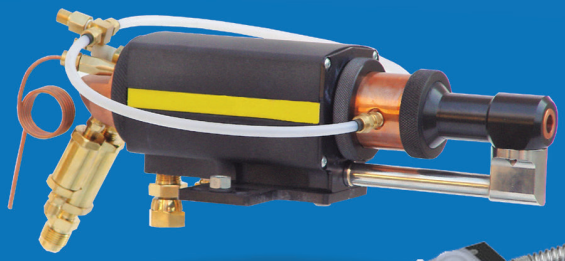

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CONTENTS

[FEATURES]

[DEPARTMENTS]

On the cover: Dimensional restoration of copper component using a SST PX manual cold spray gun. Courtesy of CenterLine (Windsor) Ltd. Photo by Gene Schilling

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Mollie Blasingame
Chair

As we reach the end of another year, I am excited to reflect on the success of our organization.

In 2022, the International Thermal Spray Association (ITSA) continued a positive growth trajectory by adding new members, developing new standards, and supporting the advancement of thermal spray technology. The year was capped off by an energetic gathering during the FABTECH show on November 9 in Atlanta, Ga.

During FABTECH, we hosted a breakfast social, member presentations, and a business meeting. It was a great success, with five companies presenting information on the latest technology each is working on. One presentation was delivered by one of our newest members, Richard Bajan of IKH, who shared his unique insights into specialized processes.

It was wonderful to speak with so many ITSA members in person, including several individuals I met face-to-face for the first time. I look forward to seeing our membership continue to grow in 2023, especially as we look ahead to our official gathering next year.

With that in mind, here's the wonderful news coming out of FABTECH. ITSA members voted to host a traditional meeting in Spring 2023 in Miami. The central location of the 2023 ITSA Symposium will be the AWS headquarters. The first day will include a series of technical presentations and a tour of the new Cold Spray and Rapid Deposition (ColRAD) laboratory at Florida International University (FIU).

The second day of the gathering will include a choice between a golf outing or an only-in-Miami type excursion. Then, we will all reconvene for a social hour followed by dinner. I encourage you to make plans to attend the ITSA meeting next year. Be on the lookout for official dates and other information for our first in-person, traditional ITSA Meeting since 2019.

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, people, 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 (800) 443-9353, ext. 295, or *itsa@thermalspray.org*.

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

Wall Colmonoy Announces $2.5 Million Modernization of Los Lunas Plant

Wall Colmonoy, a global materials engineering group engaged in the manufacture of surfacing and brazing products, castings, and engineered components, will spend $2.5 million to modernize its 52,000-sq-ft alloy products plant in Los Lunas, N.Mex. The company plans to increase capacity; improve processes; add new capabilities; and upgrade the plant's infrastructure and environment, alloy furnace equipment, and R&D laboratory.

"This investment is a reflection of our commitment to our customers to provide the very best quality products and to our team members to provide them with safe and advanced working environments," Plant Manager Kurt Boehm said.

State-of-the-art analytical equipment, including a wet/dry sieve vibrator, robotic paste dispenser, hardness tester, and vacuum mixer, have been purchased for the R&D laboratory. A modern digital microscope was installed that captures high-resolution images up to 2000× magnification. A new inductively coupled plasma (ICP) analyzer and carbon/sulfur analyzer will allow for quicker testing and reduce cycle time in the lab, a moisture analyzer will accurately assess raw materials before production to eliminate rework, and a new air jet sieve will characterize fine powder particles.

For the safety and health of its employees, the melting deck was reinforced to improve and secure structural integrity, and a central vacuum system was installed to improve dust collection. The company also purchased new fork trucks, racking, lifts, and hoists.

A view of Wall Colmonoy's Los Lunas, N.Mex., facility.

Titomic and Repkon Joint Venture Will Create Hybrid Cold Spray Manufacturing Facility

Australia-based Titomic Ltd., a global cold spray additive manufacturing technology company with primary applications in aerospace and defense, signed a comprehensive joint venture agreement with Repkon Machine and Tool Industry and Trade Inc., Istanbul, Turkey, to establish a hybrid cold spray, flow-forming manufacturing facility.

Titomic signed a comprehensive joint venture with Repkon Machine and Tool Industry and Trade to establish what it claims is the world's first hybrid cold spray, flow-forming manufacturing facility.

"The joint venture shows that Titomic's cold spray process enables metal additive manufacturing in a high-volume commercial manufacturing environment for a technically critical end application," said Herbert Koeck, managing director of Titomic. "It opens up a world of many design features for barrel manufacturing which were not previously possible."

The joint venture's facility in Turkey will leverage both Titomic's Titomic Kinetic Fusion (TKF) systems and Repkon's flow-forming technologies. This collaboration introduces new capabilities, including reduced lead times, diverse and unique material compositions, reduced weight, and improved performance, to barrel manufacturing within the defense sector.

To establish the facility, Titomic expects to sell two TKF systems to the joint venture. The systems will provide one of the two core processes in the manufacturing of barrels for the defense sector. This will include a TKF 1000, with an estimated sale price of about $1.6 million, and a bespoke TKF 3250R, with an estimated sale price of about $3.48 million. Titomic will also sell consumables (powder) to the joint venture and receive a share in profits from barrel sales.

Cellforce Group and Dürr Establish Joint Mass Production Process for Double-Sided Electrode Coating

The Cellforce Group (CFG), Tübingen, Germany, a joint venture of Porsche and battery specialist CUSTOMCELLS, and Dürr AG, a global mechanical and plant engineering company, jointly commissioned a high-tech coating facility for high-performance battery cells at Dürr's plant in Bietigheim-Bissingen, Germany.

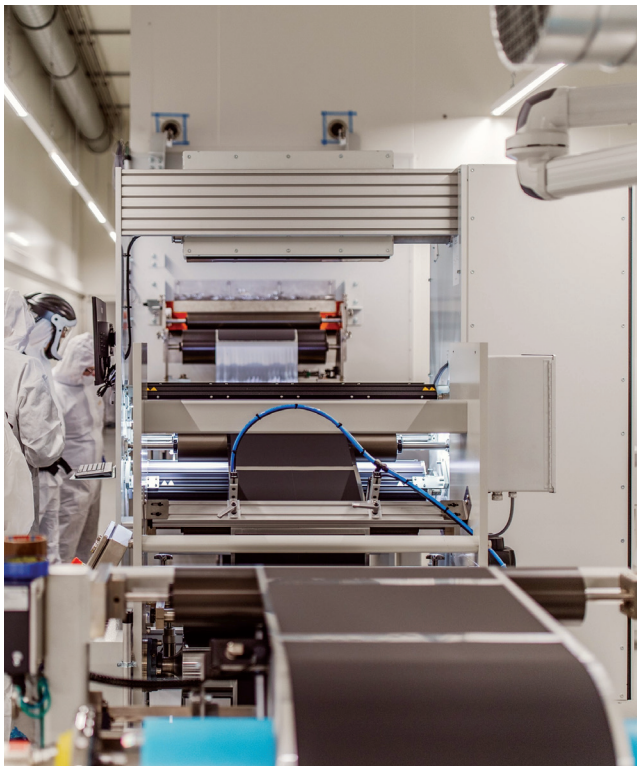
CFG will use a special process from Dürr that enables both sides of an electrode to be coated simultaneously, allowing the coating process to be accelerated and the precision and quality significantly increased when compared to the standard procedure. The company has implemented production on a factory line.

"For us, it was important that Dürr, as our technology partner, could act quickly and make possible adjustments directly," said Markus Woland, CFG's director of operations. "That's why we chose this Cellforce proprietary approach, which has greatly increased the speed of development of our coating process and allows us to build up shared knowledge at an early stage."

The technology for the double-sided electrode coating was developed by Dürr's U.S. subsidiary Megtec, which it acquired in 2018.

"We have a special technology that enables the Cellforce Group to manufacture top-quality, high-performance cells and to do so with a highly efficient and sustainable production process," said Dr. Jochen Weyrauch, CEO of Dürr AG. "By working directly with the Cellforce Group, we can optimally align the technology with their needs and thus support them in the future development and production of high-performance cells with high-energy density."

CFG is building a state-of-the-art development and production site for battery cells in the Reutlingen-Kirchentellinsfurt industrial park near Stuttgart. When completed, the production processes set up at Dürr can be taken over and continued directly. To ensure sustainable operation of the coating line, Dürr is also supplying equipment for exhaust air purification and the recovery of more than 99% of the solvents used.



The Cellforce Group will soon use a special process from Dürr that enables both sides of an electrode to be coated simultaneously. In this way, the coating process can be accelerated and the precision and quality significantly increased when compared to the standard procedure.

VRC Metal Systems Partners with Flame-Spray Industries to Develop and Market Automotive Cold Spray

VRC Metal Systems, a developer of advanced cold spray technologies based in Box Elder, S.Dak., signed a memorandum of understanding (MOU) with Flame-Spray Industries Inc. (FSI), Port Washington, N.Y., a provider of thermal-sprayed coatings. The companies plan to use their cold spray technologies, products, and processes to design, manufacture, and market to the automotive industry and the on- and off-road industrial equipment industry.

VRC is a full-service cold spray company that designs and manufactures equipment and handles the development of component repair applications, equipment integration, training, and on-site and regional support for a range of industries.

FSI has been developing and implementing advanced thermal spray services for more than 50 years and serves a wide variety of industries, including R&D, automotive manufacturing, and heavy equipment engine manufacturing. The company invented the plasma transferred wire arc (PTWA) thermal spraying process.

"VRC has enjoyed a very productive relationship with Flame Spray Industries for many years," VRC CEO Rob Hrabe said. "This new cold spray partnership will further solidify the leadership position of both companies within the automotive coatings industry."

IGS Finishes Top Three in 2022 *Hydrocarbon Processing* Awards

Integrated Global Services (IGS), an international provider of surface protection solutions, was a top-three finalist in the Best Asset Reliability/Optimization Technology category of the sixth annual 2022 *Hydrocarbon Processing*® Awards. IGS was nominated for its High Velocity Thermal Spray (HVTS) technology.

Based in Richmond, Va., IGS developed HVTS after decades of field application. The solution is designed to protect base metals in high-corrosion environments and provides many more benefits than traditional weld metal overlay (WMO), such as faster application, up-front cost reduction, and long-term return on investment.

"*Hydrocarbon Processing* received several nominations for the Best Asset Reliability/Optimization Technology category, and the HVTS technology developed by IGS was one of the highest-rated by our esteemed advisory board," said Lee Nichols, editor and associate publisher of *Hydrocarbon Processing* magazine. "The range of benefits and flexibility it can provide facilities around the world is very exciting and is a welcome industry advancement."

Recently, HVTS has been used in several renewable conversion projects, including a former refinery in eastern Canada that has been preparing to convert to processing sustainable aviation fuel. HVTS was chosen to upgrade the metallurgy to cope with the new operating environment. The project saved the refinery 50% in costs and time compared to automated welding.

HVTS is applied by an IGS technician.

Cornell Professor Wins NSF Award to Further AM Research

Mostafa Hassani was one of six Cornell University faculty members to receive a National Science Foundation (NSF) Early Career Development Award. Hassani, an assistant professor in the university's Sibley School of Mechanical and Aerospace Engineering in Ithaca, N.Y., will use the award to advance the field of additive manufacturing (AM), which is used in high-value metallic component manufacture but is sometimes limited by high process temperatures and the large associated thermal gradients and rapid cooling rates.

Over the next five years, Hassani will receive up to $600,000 from the program, which supports early-career faculty who, according to the NSF, "have the potential to serve as academic role models in research and education and to lead advances in the mission of their department or organization."

Hassani's project will further the understanding of non-melting metal AM, such as cold spray technology, in which tiny powder particles are accelerated to a supersonic speed to collide, bond together, and build up underlying materials upon impact. The research is aimed at bolstering the national defense and other industries through enabling sustainable and agile manufacturing and repair at the point of need. Hassani's team will engage educators and underrepresented K-12 students and educators through hands-on activities with a designed AM toolkit. — *Tom Fleischman,* Cornell Chronicle

Kymera International Acquires AmeriTi Mfg.

Kymera International, Research Triangle Park, N.C., a global developer and manufacturer of advanced specialty materials, has acquired AmeriTi Mfg. Co. Headquartered in Detroit, Mich., AmeriTi manufactures value-added ferrotitanium, titanium sponge, titanium powders, and specialty forms.

The terms of the transaction were not disclosed, but AmeriTi's parts business, now known as TriTech Titanium Parts, was not included in the transaction.

"AmeriTi is a growing company that culturally aligns with our mission and objectives to be the leading manufacturer of specialty materials that shape the future," said Barton White, CEO of Kymera. "[This] synergistic acquisition will give our combined company strong technical and commercial resources to help fuel our growth in the aerospace, medical, defense, and industrial markets."

AmeriTi's former owner Bob Swenson said the combined business "will continue to build the product lines and grow into new areas."

Inner-Diameter HVOF Coating System Delivers Abrasion Resistance

The IDX internal-diameter high-velocity oxygen fuel (HVOF) coating system provides a high-performance tungsten carbide nanocoating for diameters as small as 3 in., lengths up to 8 ft, and thicknesses up to 0.015 of an inch. The thermal spray system, consisting of a delivery mechanism and coating material, provides a tungsten carbide, cobalt chrome coating that delivers abrasion resistance and three times the service life of chrome-plated parts. The internal-diameter HVOF coating is also corrosion resistant and crack free. It is 99% porosity free. The system is targeted for a range of oil and gas applications, including housings, cylinders, bushings, sleeves, mechanical seals, and hydraulic cylinders.

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Report Focuses on the Impact of the Pandemic on the Powder Metallurgy for Electric Vehicles Market

Global and United States Powder Metallurgy for Electric Vehicles Market Report & Forecast 2022–2028 analyzes the impact of the COVID-19 pandemic on the powder metallurgy for electric vehicles market from a global and regional perspective. According to the report, due to the pandemic, the global market size is estimated to be worth $355.3 million in 2022 and is forecasted to reach $358.5 million by 2028 at a compound annual growth rate of 47.0% during the review period. The key manufacturers of powder metallurgy components for electric vehicles include GKN, Sumitomo Electric Industries, and more. The top five manufacturers hold a market share of about 40%. Asia Pacific is the largest market, with a share of about 52%, followed by Europe and North America with the share of about 34 and 13%, respectively. The 113-page report outlines the market size, market characteristics, and market growth, categorized by type, application, and consumer sector. In addition, it provides a comprehensive analysis of aspects involved in market development before and after the COVID-19 pandemic. The report also conducted a political, economic, sociological, technological, legal, and environmental analysis in the industry to study key influencers and barriers to entry.

Market Growth Reports
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Study Forecasts Growth in the Global Thermal Spray Market due to the Aerospace Industry

Thermal Spray Market — Growth, Trends, COVID-19 Impact, and Forecasts (2022–2027) estimates the global thermal spray market to be valued at $10,399.73 million in 2022 and is expected to reach a value of $12,729.79 million by 2027, registering a compound annual growth rate of 4.13% between 2022 and 2027. The 425-page report states that this market was negatively affected by the COVID-19 pandemic in 2020. The levels of activities were very low, and many project schedules were changed or postponed. Due to all these interruptions, industrial activities and plant construction projects across all industries were also affected. Such a global scenario negatively affected the global thermal spray market for the existing plants in the end-user industries, such as aerospace, turbines, automotive, electronics, oil and gas, and power, which were temporarily shut down worldwide. Over the medium term, the primary drivers of the thermal spray market are the increasing usage of thermal spray coatings in medical devices, the rising popularity of thermal spray ceramic coatings, the replacement of hard chrome coatings, and the increasing use of thermal spray coatings in the aerospace industry. The aerospace end-use industry dominated the market and is expected to grow significantly during the forecast period. North America dominated the global thermal spray market, owing to the expansion of end-user industries such as automotive, aerospace, power, industrial gas turbine, and others, which is expected to benefit the thermal spray materials market over the forecast period.

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Advantages of Novel Nonpressurized Powder Feeders for LOW-PRESSURE COLD SPRAY

BY JULIO VILLAFUERTE

Cold spray is a solid-state metal consolidation process that uses a high-speed gas jet to propel metal and other powder particles against a substrate where particles deform at high strain rates and consolidate upon impact. The term "cold spray" refers to the relatively low temperature involved in the deposition process, which is typically much lower than the melting point of the spray material and substrate. These attributes make cold spray uniquely suitable for depositing a range of temperature-sensitive materials. The process works on the principle of obtaining supersonic speed jets by passing compressed and heated gas through a convergent divergent (de Laval) nozzle.

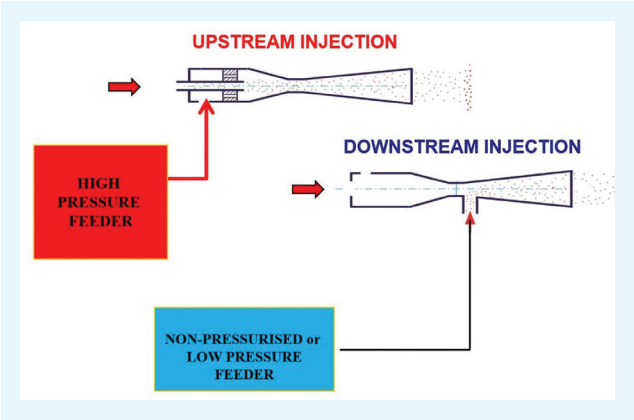

Fig. 1 — Upstream vs. downstream feeding techniques. (Courtesy of CenterLine Windsor Ltd.)

Powder Feeding

The material to be deposited is typically in the form of a dry powder, which can be injected into the supersonic gas jet, either at the convergent high-pressure side of the nozzle

Fig. 2. — A commercial slotted-wheel, low-pressure powder feeder cart assembly. (Courtesy of CenterLine Windsor Ltd.)

Fig. 3 — New non-pressurized continuous feed powder feeder. (Courtesy of CenterLine Windsor Ltd.)

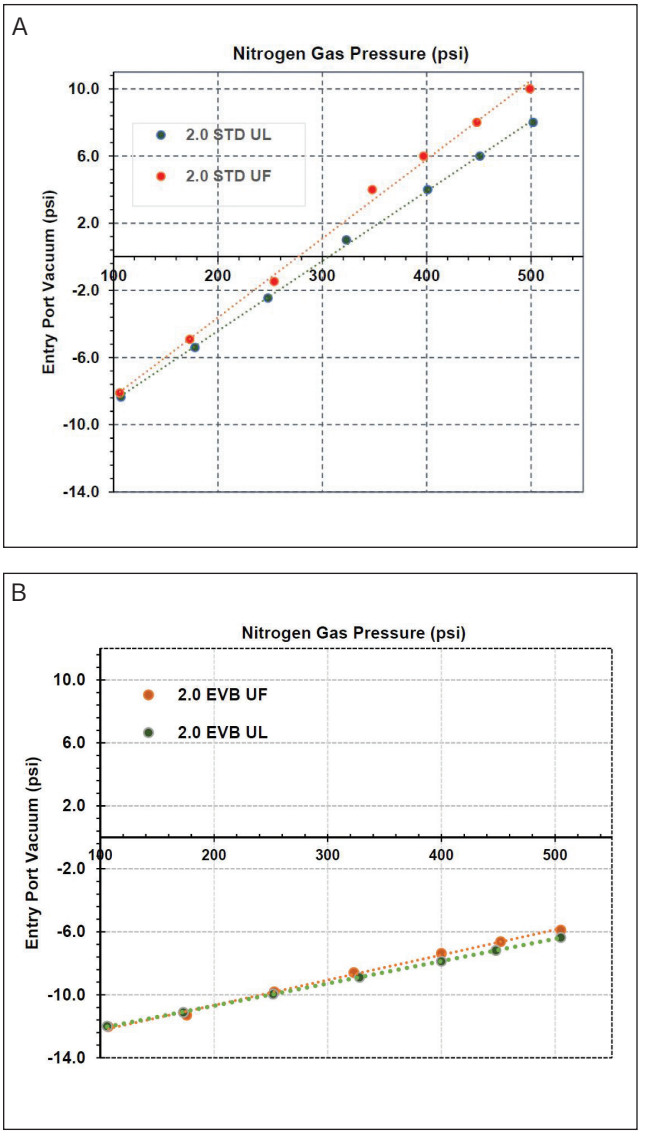

Fig. 4 —Effect of the new nozzle design on the level of downstream Bernoulli vacuum at higher upstream gas pressures in de Laval nozzles. (Courtesy of CenterLine Windsor Ltd.)

(upstream injection) or at the divergent low-pressure side of the nozzle (downstream injection) — Fig. 1.

Commercial powder feeders combine several powder feeding techniques, including volumetric positive displacement devices, the Bernoulli vacuum, vibration, gravity, and induced pressurization — Fig. 2. In all cases, a steady flow of powder to the spray nozzle significantly depends on the presence of a positive pressure differential of the carrier gas between the powder supply and the injection point at the nozzle.

In the case of upstream powder injection, the powder carrier gas pressure must exceed the pressures present at the convergent section of the nozzle, which can be up to about 60 bar, making the feeding device a pressurized vessel. In the case of downstream injection, the feeding gas pressure must overcome much lower pressures present at the divergent side of the de Laval nozzle. Depending on upstream gas pressure, nozzle design, and exact injection point along the nozzle, this pressure could even be lower than atmospheric (14.7 lb/in.^{2}) due to the Bernoulli effect at the nozzle throat.

Pressurized Feeding for Cold Spray

Since the introduction of commercial downstream injection spray units, powder feeding has relied on the Bernoulli effect present at the throat of the nozzle. This effect, combined with gravity and vibration, often generates enough powder flow at relatively low spray gas pressures (less than 12 bar). At higher spray gas pressures, the minimum pressure

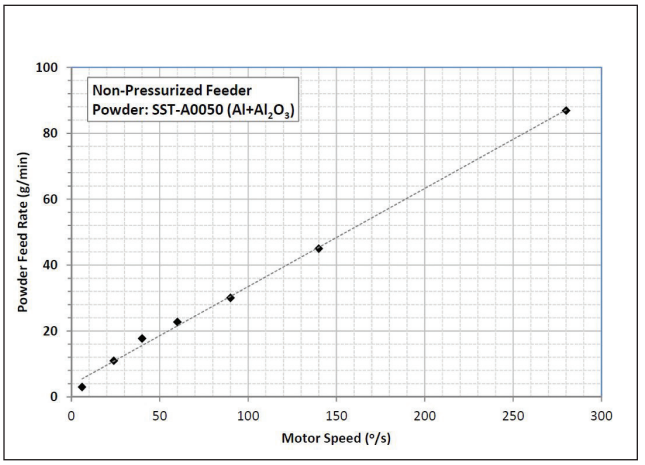

Fig. 5 — Relationship between feed rate control and actual feed rate (g/minute) in the new non-pressurized powder feeding systems.

at the nozzle throat increases, which reduces the Bernoulli effect in relation to atmospheric pressure. The latter makes non-pressurized powder feeding devices insufficient for consistent powder feeding at higher spray pressures. Subsequently, the use of traditional slotted-wheel pressurized powder feeders became a necessity in downstream injection units operating at higher pressures. However, as applications grew into mass production applications requiring higher gun travel speeds and other industrial demands, the limitations of slotted-wheel pressurized feeders became apparent. Some of these limitations included the occurrence of wavy or regularly inconsistent spray deposition patterns at high travel speeds (> 1000 mm/s). Additionally, slotted-wheel pressurized feeders presented challenges, such as difficulty feeding nonfree flowing powders (amorphous), seizing with soft powders, limited feed range tied to slot configuration, inconsistent feed rate from full-to-empty, and tedious cleaning and maintenance.

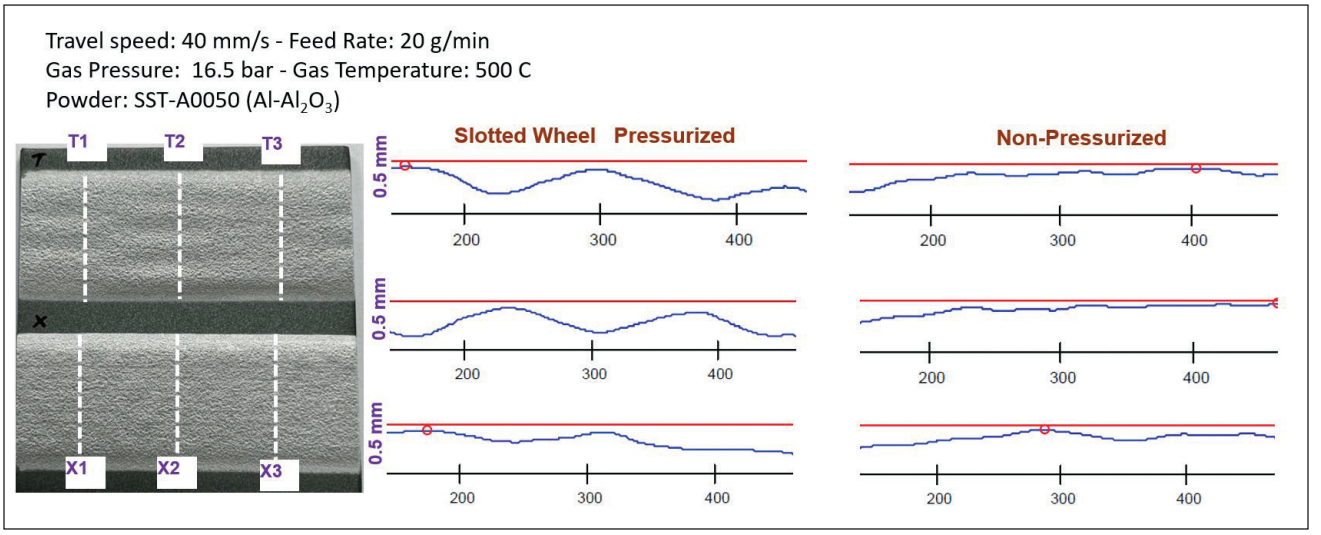

Fig. 6 — The occurrence of wavy deposition when spraying with slotted-wheel powder feeders. (Courtesy of CenterLine Windsor Ltd.)

Maintenance-Operational Cost (USD)

User: Automotive Customer
Application: Production Repair of Al Castings
Duration: 1 year / 900 spray hours
Material: SST-A0050
Feed Rate: 20 g/min
Powder Usage: 1080 Kg (2,376 lbs)

	Slotted Wheel Presurized	Non-pressurized
Maintenance Interval (spray Hours)	40	900
Seals and spare parts (USD)	$458 x 22.5 **($10,305)**	$20 x 1 **($20)**
Time to change seals and spare parts (Hr)	2.7 x 22.5 (**60 hours**)	1.5 x 1 (**1.5 hours**)
Labour to Change parts (Labour @ $50/hr)	$3,000	$75
Total cost every 900 Hrs.	**$13,305**	**$95**
Cost per lbs Sprayed	$5.60	$0.04
Non productive % / Hrs	6.7 %	< 0.5%
Feed Gas (Nitrogen)	$4 x 900 = $3,600	$0

Fig. 7 — Comparing the cost of maintenance between a slotted-wheel pressurized feeder and the new non-pressurized feeders for downstream injection cold spray.

New Non-Pressurized Feeding for Low Pressure Cold Spray

The development of the new non-pressurized powder feeding technology (Fig. 3) involved maximizing vacuum at the nozzle injection point by optimizing the nozzle design. The new design promotes significant negative pressures (below atmospheric) downstream around the nozzle throat for higher gas stagnation pressures at the high-pressure side of the de Laval nozzle — Fig. 4.

The combination of better vacuum along with volumetric feed through continuous positive displacement and vibration led to new feeding devices that are more consistent. Figure 5 illustrates the relationship between the actual feed rate (g/minute) and the step motor speed that controls the continuous positive displacement feed device.

Another advantage of the new non-pressurized feeding technology relates to better deposition consistency at increasing gun travel speeds — Fig. 6. This is ascribed to the continuous nature of the mechanical displacement feed device as opposed to mechanical displacement devices that move the powders in discrete regular pockets of material.

Low Maintenance Cost

One of the ultimate advantages of a newer non-pressurized powder feeder is its low cost of maintenance compared to previous generations'. Figure 7 illustrates a side-by-side comparison of the actual cost of maintenance between a traditional slotted-wheel feeder and a new non-pressurized feeder for a real-life production study within an automotive production cold spray environment. According to this study, with this application, the maintenance costs for one feeder device represent only a small fraction of the normal maintenance costs of one standard pressurized feeder device. That makes it more than 90% more economical to maintain.

Conclusion

The new non-pressurized feeder technology for downstream injection cold spray promises operational capabilities that are quite appropriate for a number of emerging production applications for cold spray technology.

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BY MARJORIE ANGELO

Cover of Jeff: Sprayed Molten Metal on Canvas

Thermal Spray Art

How One Artist Turned Molten Metal into an Art Form

It is said that artists often view the world as raw materials they can use to create. For one artist, it isn't just the world he sees differently but the mediums that can be used to create art.

During the 1970s and 1980s, Jeff, an artist, gave up wood sculpture, watercolors, and acrylics for a new medium — molten metal heated between 787° and 4000°F and sprayed onto canvas through a spray gun used to coat spacecrafts. He called his technique "metalizing."

Metalizing Canvas

Donning a heat-protective bodysuit and a helmet with a face shield, Jeff began to experiment with adhering molten metal onto canvas. He succeeded by applying thick layers of textured acrylic medium, allowing the metal to bite into the surface and hold rather than slide off. Spraying a base layer of molten zinc before adding hotter-burning metals, such as copper and steel, protected the canvas from scorching. From

Fig.1 — A — Jeff at work on Slate*, 1977, spraying molten zinc over acrylic on canvas. B — Slate, 1977, the finished piece measures 75 × 75 × 12 in.*

1974 to 1984, Jeff created 35 large and 100 small abstract metal works for exhibition in art galleries and acquisition by museums and private collectors.

As he got more passionate about his art form, Jeff started to explore structure vs. nonstructure. He would divide his canvases into two parts, arranging one side over a three-dimensional armature and the other side without structured support. He played with more-subtle effects, highlighting the raised painterly swirls on the surface and incorporating a cross hatching of controlled linear marks, sometimes in combination with sweeping curves. He abraded the surfaces with electric belt sanders and other tools, scratching through the top layers to expose hidden metallic colors and, in some places, the textured acrylic layer below. He added chemical patinas to colorize and transform the artworks. In the end, he left the surfaces unsealed, letting the skin breathe, and allowing the metals to gradually change.

Jeff's sprayed metal works, neither paintings nor sculptures, presented a hybrid blend of different art forms. The artworks dominated exhibition spaces while challenging conventional norms. Each was hung 6 in. above the floor, rather than centered visually at eye level, shifting the focal point well below eye level and prompting a consideration of the artist's intentions with the unusual display.

A 1977 piece titled *Slate* is one of the first successful sprayed metal works — Fig. 1. It is entirely sprayed zinc with a sanding of the surface to a luster. It demonstrates a recurring theme in Jeff's work: the contrast of hard-stretched canvas to a soft, drapey flap. Zinc was determined to be the first undercoat of metal because it could be sprayed at a cooler temperature, which did not burn or damage the canvas. Steel and copper followed the zinc step in subsequent works, as did chemical patinas.

Art Critics Take Notice

Though difficult to categorize, Jeff's metalized canvases were well-received in critical reviews and garnered international attention. The canvases were hung in shows in New York City as well as in museum exhibitions, and private and public collections throughout the world. He was awarded a National Endowment for the Arts Visual Artists Fellowship Grant for his metalized canvases work.

Fig. 2 — Serious Art, 1981, features flashing electrical bulbs along with sprayed molten steel on canvas measuring 71 × 121 in. It is in the collection of the Neuberger Museum of Art, Purchase, N.Y.

Contemporary reviews of the canvases recognized the groundbreaking aspects of Jeff's use of thermal spray to create art.

In the May 1978 issue of the now defunct *Arts Magazine*, critic Hedy O'Beil commented that "Jeff appears to be an artist who wants a foot in both camps (old and new) . . . He selects an industrial product, molten metal, and . . . sprays the liquid onto a prepared canvas. This medium, borrowed from the world of modern technology, is then distressed, scratched, rubbed, burnished, so that the surface resembles a piece of archaic metal wall, replete with marks and oxidized colorations as a result of exposure and time. Within the stark metalized work, convex and concave, flat or bent expanses are coupled, producing both two- and three-dimensional form; consequently they are neither paintings nor sculptures."

William Zimmer of the *SoHo Weekly News* wrote in September of 1979, "Jeff's work lies in that territory between sculpture and painting. They are formidable banners."

In another review in *Arts Magazine* from January 1980, critic Robbie Erhlich stated, "Jeff's works . . . exist between opposing pairs of concepts. This duality is manifest on their most fundamental levels where they may be described with equal validity as paintings or architectural reliefs. Because neither aspect is dominant or compromised, both coexist in an integral aesthetic security."

Ivan C. Karp, an early advocate for pop art artists Andy Warhol, Roy Lichtenstein, and Claes Oldenburg, pioneered the SoHo gallery district in Manhattan in the 1960s. When opening his OK Harris Works of Art gallery in 1969, he sought artists creating "the broadest spectrum of the most adventuresome art." In 1979, the OK Harris Works of Art gallery promoted its exhibit of Jeff's metalized canvases in a press release, describing the works as "shaped canvases coated with sprayed molten metal . . . comprised of two sections similar in size and shape, the two halves differing in that one is stretched, the other unstretched. Brought together by the uniformity of surface, the metal acts both visually and physically as a structural element."

While all pieces of their work are special to an artist, Jeff is especially fond of his 1981 work titled *Serious Art*, an artistic and technical feat. For this piece, 1310 yellow and red hand-dipped bulbs were soldered into a zigzag sign under a flap of steel metal canvas. The bulbs were synchronized to flash in three different sequences of color combinations. Marcia Tucker, founder of the successful New Museum in New York City, known for identifying new talent and curating their work for her shows, placed *Serious Art* at the entry of her 1984 show Not Just For Laughs: The Art of Subversion. It is now in the collection of the Neuberger Museum of Art in Purchase, N.Y. — Fig. 2.

New Book Explores Jeff's Art

A new book, *Jeff: Sprayed Molten Metal on Canvas* (see lead photo), is a documented record of his metalized canvases, a body of work that challenges perceptions of painting and sculpture. The book opens with an essay that provides background on the traditional use of thermal spray for protection and restoration while also promoting it as an unconventional and dynamic artistic medium. A critical art historical essay by Museum Director and Curator Klare Scarborough explores Jeff's metalized canvases as "Conceptual Works in Space." Some of her text has been incorporated into this article with her permission.

Conclusion

"Artists have a need to make something they haven't seen before, expressing themselves in creating objects that haven't yet existed," Jeff explained regarding his exploration of thermal spray as an artistic medium. "My interest started as an interest in the technology, to see what it could do and whether it could be used in the creative art process at all. Ultimately, I like the way that light travels across the surface, keeping the work alive."

Copies of Jeff's book can be purchased by contacting him directly via email at *jeffart@epix.net*.

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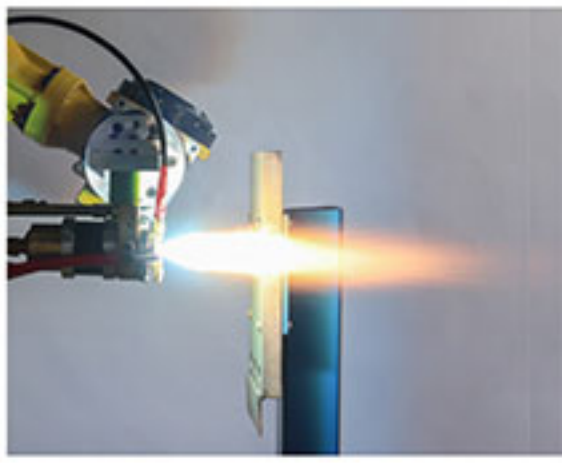

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