DURALAR: The Most Advanced Hard Coatings On the Planet

It's a whole new generation of diamond+metal coatings for a broad spectrum of applications
Duralar is an advanced and uniquely structured nanocomposite coating that provides exceptional hardness, toughness, strength and a spectrum of performance qualities. It is comprised of multiple layers that can be configured in multiple ways for many purposes, and it can be deposited with unprecedented speed.

In addition to durability and lubricity Duralar also provides excellent corrosion and erosion resistance. And it is environmentally friendly, as well. Because of these unique capabilities Duralar is finding use in a great many industries in a wide range of applications.

**Exceptional hardness and wear performance**

Duralar™ is a proprietary and patented nanocomposite containing both metal and diamond components. The metal gives it toughness, the diamond gives it exceptional wear resistance, and the combination is extraordinary. Duralar hard coatings can be much thicker than conventional coatings, and they actually contain clusters of diamond material, giving them significantly greater durability.

In addition, Duralar has greater thermal stability than many other coatings. So it is does not degrade and is able to maintain its high performance even at sustained elevated temperatures. Plus, the specific hardness and toughness of a Duralar coating can be fine-tuned by adjusting the formulation of its component layers, enabling it to deliver exceptional wear performance for a wide range of applications.

**Low friction and natural lubricity**

Duralar is an extremely smooth coating with a very low coefficient of friction. Plus, its carbon content gives it a natural lubricity. In many applications such as engine parts this can significantly improve power and performance while extending service life — by reducing failure rates, downtime and the need for maintenance.

Duralar can dramatically decrease the problems of scaling, fouling, galling, fretting and a host of other friction-related issues, and this can lower the cost of operation considerably.

**Superior corrosion and erosion resistance**

Corrosion results from a metal atom being oxidized by moisture or corrosive chemicals and losing one or more electrons, which causes gradual destruction of the metal. In many indus-
are finding it more problematic and expensive to use coatings like hard chrome, and they have been searching for more eco-friendly options. For these users Duralar is a natural solution. It is non-toxic, inert and benign, and the Duralar coating processes pose no human hazards and generate no waste products. Advanced Duralar coatings are friendly to people and to the environment.

**A more conformal coating**

Other coating processes such as hard chrome plating and thermal sprays are known for their lack of uniformity. Because they are directional processes their coatings tend to be thicker on corners and edges and thinner on recessed areas. Consequently, those processes require follow-up machining to meet dimensional tolerances, and that extra step adds production time and expense.

Duralar, by contrast, is not a sprayed coating, so it does not have the limitations associated with line-of-sight application. Instead, Duralar coating is inherently conformal. It covers three-dimensional features very consistently, even screw threads and intricately shaped features which can be challenging for other coating methods. Duralar maintains very precise dimensional tolerances without the need for post-processing — saving time and money and streamlining your processes.

**Advanced coating — that's also eco-friendly**

Many metal coating processes such as chrome plating pose serious threats to the environment and human health. Chromium-6, for example, has been classified as a likely carcinogen. And because of this, regulations around the world are increasingly being tightened to control the offending processes. Consequently, many industries are finding it more problematic and expensive to use coatings like hard chrome, and they have been searching for more eco-friendly options.

For these users Duralar is a natural solution. It is non-toxic, inert and benign, and the Duralar coating processes pose no human hazards and generate no waste products. Advanced Duralar coatings are friendly to people and to the environment.

**Much faster deposition**

Deposition speed is a significant competitive advantage of Duralar coatings. Prior to Duralar it was not practical to apply deposition coatings that were thick enough to replace hard chrome or HVOF (High Velocity Oxy Fuel) coatings, because depositing the necessary thickness could take an entire day! However, Duralar coatings are comprised of relatively large molecules — essentially, bigger "building blocks." This means Duralar can create thicker coatings much faster — often four to five times faster — than many other competitive coatings, such as conventional PVD (Physical Vapor Deposition), for example. So what might have taken a full day before can now be completed with Duralar in just a few hours.

Whether your requirement is for thick or thin coatings, all can be deposited faster with Duralar. And with your own high-efficiency Duralar systems in place you can shorten schedules and maximize product quality. Bottom line: With faster cycle times and a higher quality product you can reduce production costs and increase your profits!
Customizable

Duralar coatings are unique in that they are comprised of layers of metal and diamond-based components. This gives them unprecedented hardness and toughness and creates a more impervious barrier against corrosion and other attacks to the underlying substrate.

Having multiple layers also enables Duralar’s performance to be tailored to specific applications by adjusting the composition and thickness of individual layers. For example, a coating can be made more or less hydrophobic, or tough, or hard, or wear-resistant, or brittle, or it can be modified in any number of ways to enhance performance for a particular application.

A broad spectrum of applications

Duralar is an advanced hard coating that combines superior performance with practical usability. It replaces hard chrome, thermal spray and other industrial hard coatings and serves the general technical coatings market, as well. With its exceptional hardness, wear and lubricity, its corrosion and erosion resistance, plus its faster, easier application and affordability — Duralar serves many traditional metal coating needs, and enables many new ones, in a broad range of industries, such as...

- Oil & Gas
- Automotive
- Aerospace
- Pulp & Paper
- Chemical Processing
- Firearms
- Power Generation
- General Industrial
Replacing hard chrome

Hard chrome plating has long been used in a range of general industrial applications. In the past it proved useful because it offered moderate hardness and corrosion resistance, relatively easy application and reasonably low cost. But unfortunately, hard chrome also has a number of fundamental limitations...

Chrome's limited hardness and corrosion resistance can cause problems in many applications. If not properly applied, chrome can suffer from pitting, spalling and other failures under high-stress conditions. Also, chrome's relatively slow rate of deposition can be a serious drawback, especially since it requires lengthy post-deposition processing. And parts used in demanding applications, such as hydraulic rods, may need to be plated three or four times to obtain a sufficiently thick hard coating. Uneven coating is a further problem for chrome plating. Because electroplating is a directional process, chrome coatings tend to be thicker on the edges and corners and thinner on recessed areas. For this reason, a follow-up machining step is required to restore critical dimensions, which adds cost and additional time to the process.

In addition to performance issues, chemical pollution is a fundamental problem for chrome plating. The process uses carcinogenic chemicals and creates serious occupational and environmental hazards. For that reason, chromium is being regulated more and more tightly throughout the world, and this is causing users to look for more eco-responsible alternatives.

Duralar fits that need very well, and it also exceeds chrome's performance on virtually all fronts: To begin, since it is a nanocomposite of diamond and metal Duralar is significantly harder, more durable and has greater lubricity. In addition, since it is amorphous and is made up of layers Duralar provides much greater resistance to corrosion and erosion. Duralar is also able to create much thicker coatings much faster. Plus, Duralar produces a more evenly conformal coating than chrome, enabling it to maintain tight dimensional tolerances without the need for post-processing.

Bottom line: Duralar delivers an advanced hard coating with important performance advantages while being faster, easier to apply and without harming the environment. And at the same time, Duralar costs remain competitive with or even lower than hard chrome.

Replacing thermal spray

The various types of thermal spray coatings, including HVOF (High Velocity Oxygen Fuel), are created by melting a feedstock material — usually a metal, alloy, carbide or ceramic — and spraying it onto a part, creating a molten coating. Thermal sprays can produce dense coatings with strong bond strengths, but these coating processes also have certain inherent challenges...

The greatest drawback for thermal spray is usually cost. Thermal spray is most often applied by a robot, which must be programmed for the specific part to be coated, and frequent adjustments must be made for parts with complex geometries. Unlike chrome plating which coats an entire surface at once, thermal spray is usually applied to small sections at a time. For large, simple surfaces thermal spray may be applied more cheaply than chrome; but for complex geometries thermal spray processing is usually much more expensive.

Another basic difficulty with thermal spray is that it is a line-of-sight coating process. To coat features that lie outside the line of sight, such as inner diameters beyond a couple of inches, other coating methods must be used. In addition, thermal spray coating usually requires a further machining step to achieve critical dimensions, which adds further time and expense.

Duralar, by contrast, has no line-of-sight limitation and is able to coat inner diameters and complex 3D features with high conformity — and with strong bonds that are superior to thermal spray. With its unique, multilayer, nanocomposite blend of metal and diamond coating material, Duralar provides not only greater hardness, longer wear and greater lubricity but also superior corrosion and erosion resistance. And it accomplishes all this with a faster, simpler, more streamlined process that requires no final machining to achieve precise tolerances. Duralar delivers a superior hard coating at a more attractive price — making it a very effective replacement for thermal spray coating.
A SELECTION OF ADVANCED HARD COATINGS

Duralar Technologies offers an array of different hard coatings to cover a broad range of applications and needs across many industries. Note that Duralar is also able to vary the characteristics of the following basic coatings to address a user’s specific requirements.

Duralar WearGuard
In Duralar WearGuard coatings the metal component provides toughness, the diamond component provides exceptional wear resistance, and the combination delivers extraordinary overall performance. These Duralar coatings can be significantly thicker than conventional coatings, and they contain molecular diamond structures within the matrix to create a very durable material for numerous applications that are subject to wear.

Duralar ArmorLube
The unique Duralar ArmorLube™ coatings provide a combination of dry lubrication and exceptional hardness to enhance the performance of a range of metal products and parts in firearms, automotive, oil & gas and other industries. The coating is created from a proprietary carbon-based formula, with the carbon providing a natural graphitic lubricity and an extremely low coefficient of friction — less than 0.1. ArmorLube coating is well suited to applications that require a clean, dry, permanent lubrication — without needing oils or greases, which can accumulate dirt and cause fouling.

Duralar Sliding Wear Control
Duralar’s Sliding Wear Control coatings are specifically designed for use in applications that are subject to adhesive wear from the sliding motion of parts such as in reciprocating pistons and pumps. Many of these applications are found in automotive, oil & gas, and other heavy industries. Application environments may include wet, dry, oil and drilling mud.

Duralar Abrasive Wear Control
Duralar’s Abrasive Wear Control coatings provide additional thickness for applications requiring maximum resistance against hard-particle abrasion, such as wear from particles in a slurry flow. This coating tests very favorably in ASTM G65 wear resistance.

Duralar Decotech
The Duralar Decotech coating is a hybrid between a decorative coating and a technical performance coating. This hard coating provides a lustrous finish for an aesthetically pleasing effect combined with outstanding protection against scratches and corrosion. It can be an effective and handsome solution for a range of uses from fashion to firearms to architectural features.
**DURALAR SYSTEMS — TO PUT YOU IN CONTROL**

Installing Duralar coating equipment in your own production lines can bring considerable savings in time and expense. You can dramatically streamline product cycles and eliminate the cost and delay of shipping to remote coating vendors. If you wish, you can gain the efficiencies of coating just-in-time rather than in batches. You’ll get all the performance benefits of Duralar coating technologies while maintaining complete control of your specific coating process and the final product. Duralar offers a selection of systems to address a spectrum of hard-coating applications...

**Duralar Centurion: External Coating**

The Duralar Centurion™ deposition system is a versatile hybrid design for advanced coatings incorporating both PVD and PECVD processes. This system is configured for productive, cost-efficient industrial batch coating and is designed to provide high-volume production for medium/small size pieces, or lower-volume high-mix pieces. Parts being coated are rotated in a planetary motion for optimized uniformity.

The chamber is fully equipped with heaters, turbo pumps, a dry roughing pump, and mass flow controllers, as well as a delivery system for the liquid molecular diamond precursor. All hardware is controlled through an advanced programmable logic controller (PLC) and an intuitive human machine interface (HMI). Processes are automated through recipes and can be easily transferred from the Duralar R&D center to tools at customer sites.

**Duralar Maximus: Internal Coating**

The Duralar Maximus™ system is designed for coating the interior surfaces of parts. It accommodates ten identical component setups of high aspect ratio parts. This chamber-based PECVD system utilizes pulsed DC and ten separate gas feeds and electrical splitters for uniformity across the ten substrates. The system is equipped with a dry pump and booster, heaters, mass flow controllers and valves controlled by an advanced PLC and intuitive HMI with recipe control and remote data logging.

**Duralar CS-10: Internal Coating**

The Duralar CS-10 coating system incorporates the InnerArmor™ technology originally developed by Duralar’s Sub-One subsidiary for specialized internal coating. The CS-10 utilizes patented hollow-cathode ion immersion processing, and its flexible design enables it to apply surface enhancements that can be tailored to a range of applications. InnerArmor coatings are applied to internal surfaces via PECVD technology which enables the coating of complex interior geometries without line-of-sight limitations.

The CS-10 is equipped with vacuum heads with KF100 flanges for easy connection to the parts to be coated, enabling each part to act as a chamber. The heads provide gas delivery and evacuation as well as anode housing. The system is equipped with a high-power DC power supply, an asymmetric bipolar DC pulsing system, eight mass flow controllers and associated valves. It is controlled by a PLC and intuitive HMI with recipe control and remote data logging.

**Duralar Emperion: Internal and External Coating**

The Emperion™ is designed for high-throughput deposition on the interior and exterior surfaces of metal parts. Twin deposition chambers optimize operator efficiency and allow virtually continuous coating. Lightweight, modular, custom-designed fixtures make for faster, easier transfer of parts into and out of the chambers; and special quick-change chamber shields dramatically reduce the need for chamber-cleaning downtime.

Duralar’s proprietary DualArmor™ PECVD process bathes metal parts in an extremely dense plasma that coats all surfaces, including complex 3D shapes, with high uniformity. The Emperion’s two standard deposition chambers are vertically oriented, each 40 inches by 10 inches in diameter. Custom equipment configurations also may be created to meet specific user requirements.
Duralar Technologies is a global nanotechnology company and developer of the state-of-the-art Duralar family of ultra-hard coatings. The diamond- and metal-based next-generation products are designed to replace hard chrome plating, thermal spray and other previous generations of hard coatings across a broad range of industries, including oil & gas, automotive, aerospace, firearms, pulp & paper and more. The company develops, sells and supports advanced Duralar coating systems and can also provide Duralar coating services for selected customers.