Extracting More Value from Oil and Gas Assets

Teflon™ Industrial Coatings in the Oil and Gas Industry

Teflon™
industrial coatings

Chemours™

A Track Record of Innovation and Inspiration

The process of extracting and transporting oil and gas has traditionally been beset by challenges. Over the years, however, advances in technology have meant both improvements in upstream and midstream processes and the ability to extract from evermore challenging environments. Despite this improvement, some things don't change. Conditions are invariably demanding — especially offshore, where corrosion is a constant threat. At the same time, demands to cut capital costs and maximize profits are juxtaposed with a growing number of environmental regulations.

It's little wonder, then, that coating systems able to protect vital plants from harsh conditions — as well as help ensure longer life and enable more efficient functioning — have become an essential factor for engineers to include in their designs. Everyday maintenance of assets in these challenging environments is not a practical option; so, in order to prolong the working life of coatings, they must be able to resist saltwater corrosion, UV rays and wide temperature ranges.

Anything with a thread is at risk, as are tanks, valves, flow sensors, blowout preventers, manifolds, seals, gaskets, tooling, and a myriad of other vital equipment and components. It's a long list of vulnerable parts that need protecting, and that protection involves both upfront and ongoing maintenance costs in such difficult and dangerous conditions.

Failure to address these environmentally related issues can result in more than disruptive equipment failures — it can result in major failures and costly accidents. If we look at the pure financial costs, a recent NACE International study found that in the U.S. alone, corrosion costs the oil and gas exploration and production (E&P) sector more than USD 1 billion.

The bottom line is that choosing the best industrial coating — one that delivers intumescent and heat-resistant properties, high levels of abrasion resistance, and extended durability to increase component life — will make a substantial difference in both safety and profitability.

Effective, Established Solutions That Are Securing Results

Over the last 30 years, Teflon™ coatings have demonstrated superior performance and durability. While standard coating solutions such as cadmium and zinc plating have been the mainstays of the industry, these simply do not have the required properties to provide adequate, long-lasting protection in harsh offshore environments.

In such conditions, where corrosion, UV light and extreme temperatures are often the norm, polytetrafluoroethylene (PTFE)-based coating systems offer significant improvements in performance and durability.

The reasons are many. PTFE coatings offer excellent nonstick properties that help to ensure the efficient operation of parts and equipment while reducing wear. They also offer increased corrosion protection. In addition, they demonstrate temperature resistance at both extremes of the scale — from -200 °C (-328 °F) up to 260 °C (500 °F).

With properties such as these, PTFE industrial coatings have become the go-to choice as an integral surface component for a wide variety of mission-critical components throughout the oil and gas industry.

A Track Record of Innovation and Inspiration

The brand Teflon™ has become synonymous with nonstick coatings. The product — just as the company behind it — has a long history of innovation, evolution, and technological advancements that has meant Teflon™ coatings have not just moved with the times — they've moved ahead of them.

The story began on April 6, 1938, when Dr. Roy J. Plunkett (1911–1994) observed a frozen, compressed sample of tetrafluoroethylene, only to discover that it had polymerized spontaneously into a white, waxy solid, later named PTFE.

The Teflon™ trademark was registered in 1945, with the first products sold in 1946. PTFE revolutionized the plastics industry, and applications and innovations snowballed quickly.
In 1990, U.S. President George H.W. Bush presented the National Medal of Technology to the inventors of Teflon™ for their pioneering role in the development and commercialization of man-made polymers.

Dr. Roy Plunkett was inducted into the Plastics Hall of Fame in 1973 and, in 1985, joined such distinguished innovators as Thomas Edison, Louis Pasteur, and the Wright brothers in The National Inventors Hall of Fame. Dr. Plunkett's history of achievement is commemorated globally with Chemours' Plunkett Awards for Innovation with Teflon™.

Teflon™ fluoropolymer has become the prime choice for a broad range of material applications due to its unique characteristics, which include:

Non-sticking

Very few solid substances will permanently adhere to a Teflon™ finish. While tacky materials may offer some adhesion, nearly all substances release easily.

Low coefficient of friction

The coefficient of friction with Teflon™ coatings is generally in the range of 0.05–0.20, depending on the load, sliding speed, and particular Teflon™ coating used.

Non-wetting

Because surfaces coated with Teflon™ fluoropolymers are both oleophobic and hydrophobic, they are not readily wet, making cleanup easier and more thorough. In many cases, surfaces are self-cleaning.

Superior thermal stability

Many Teflon™ coatings withstand severe temperature extremes. They may be considered for use at temperatures as low as -270 °C (-454 °F). Teflon™ coatings can operate continuously at temperatures up to 260 °C (500 °F) and be used for intermittent service up to 315 °C (599 °F).

Recoatable

This allows more coatings to be applied at the end of the curing process, which enables blemishes to be covered, film thicknesses to be increased, and defects repaired.

Unique electrical properties

Over a wide range of frequencies, Teflon™ coatings have high dielectric strength, a low dissipation factor, and very high surface resistivity. They can even be made electroconductive enough to be used as anti-static coatings.

Chemical resistance

Teflon™ fluoropolymers are normally unaffected by chemical environments. The only chemicals known to affect Teflon™ coatings are molten alkali metals and highly reactive fluorinating agents.

UV resistance

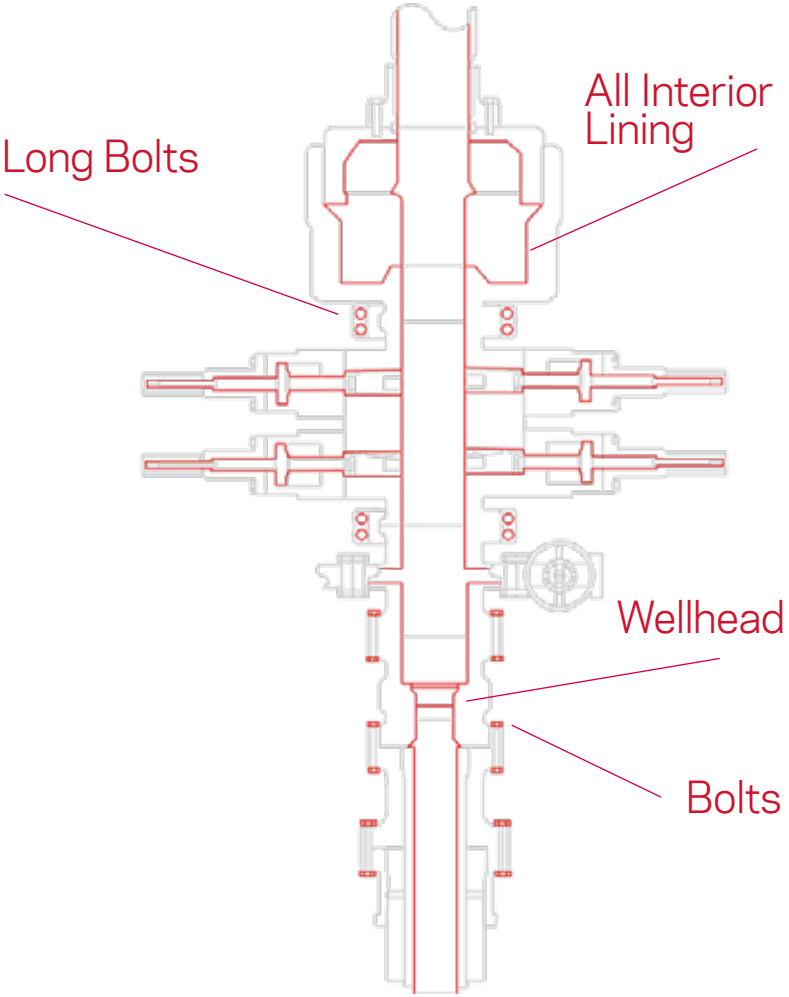
Teflon™ coatings protect substrates against extended UV exposure.

Why Engineers Prefer Teflon™ Industrial Coatings

Applying Teflon™ coatings in offshore oil and gas applications offers a range of benefits, including:

- **High UV resistance as compared to other PTFE coatings.** Due to Teflon™ coatings' durable corrosion resistance — as demonstrated by unrivaled results in salt spray tests — they boost equipment reliability and operational safety.
- **Increased productivity via enhanced components' performance.** Bolts coated with Teflon™ fluoropolymer, for example, have high heat resistance, enhanced chemical resistance, excellent release, a low coefficient of friction, and consistent tensioning — all in addition to being easy to install and remove.
- **High cost efficiency** due to higher life expectancy and lower maintenance costs.
- **Simplicity in application and recoatability.** Teflon™ fluoropolymer coatings can be reflowed after final cure and can be used on a variety of substrates, such as aluminum, carbon steel, and stainless steel.
- **Increased environmental friendliness.** The Teflon™ water-based system, specifically developed for offshore applications, offers a one-coat solution that provides excellent corrosion resistance that is easy to clean up, heavy metal-free, low on VOC emissions, and requires no special solvents beyond water for cleanup or thinning.
- **Excellent customer service.** Teflon™ coatings are delivered via specially selected value chain partners who focus on education and innovation with customers. This comes in addition to fast response cycles, on-time shipping, and in-stock supplies of Teflon™ coatings.

You can see from the illustration below that these benefits make Teflon™ coatings effective across a wide range of application points.



How Teflon™ Industrial Coatings Perform Relative to the Competition

The Recoatable Properties of Teflon™

The recoatable feature and special chemistry of Teflon™ coatings contribute to an exceptional consistency, leading, as a result, to high UV protection and excellent resistance, as demonstrated in salt spray tests.

Unlike other conventional coatings, the recoatable feature of Teflon™ fluoropolymer allows more coatings to be applied after curing in order to fix blemishes, increase film thicknesses, or repair defects.

Recoating is applicable once the coated section is fully cured and has cooled to ambient temperatures. Once cool, more coatings may be applied.

These unique features all contribute to the durability and cost-effectiveness of Teflon™ coatings.

Significant UV Resistance

Recent testing demonstrates the UV resistance and coating consistency of Teflon™ fluoropolymer.

In a 12-month simulated exposure test (method J-160), Teflon™ coatings demonstrated three times better UV resistance over competitive PTFE-based coatings. (Access to the full report can be provided by Chemours or its partners upon customer request.)

Six-Month Simulated Weathering Test, Method J-1960

Sample	Start DFT	End DFT	△ DFT	Loss	% Loss
Competition	0.98	0.67	-0.31	**-0.32**	-32.65 avg
Competition	0.98	0.65	-0.33		
857G-508, 450F	0.72	0.70	-0.02	**-0.05**	-6.94 avg
857G-508, 450F	0.72	0.64	-0.08		
857G-508, 500F	0.83	0.68	-0.15	**-0.12**	-13.86 avg
857G-508, 500F	0.83	0.75	-0.08		

Twelve-Month Simulated Weathering Test, Method J-1960

Sample	Start DFT	End Dft	△ DFT	Loss	% Loss
Competition	0.98	0.55	-0.43	**-0.43**	-43.88 avg
Competition	0.98	0.55	-0.43		
857G-508, 450F	0.72	0.63	-0.09	**-0.08**	-10.42 avg
857G-508, 450F	0.72	0.66	-0.06		
857G-508, 500F	0.83	0.72	-0.11	**-0.11**	-12.35 avg
857G-508, 500F	0.85	0.75	-0.10		

Advantages in Coating Consistency

In one of the tests (performed according to IAW ISO 16047:2005[E] on ten [10] M10 bolts coated with a blue lubricious Teflon™ coating*), Teflon™ coatings on M10 nuts and square washers delivered very high consistency.

Quote from the test report:

"Observations: Subject corrosion and chemical-resistant coating is moderately lubricious based on coefficient of friction and K factor. Lubricity is a function of the type and amount of lubricating agent in the coating, adjustable by formulating for a particular application. The subject coating is remarkable in that it exhibits extremely consistent results for such a small sample size. For ten (10) sample sets of coated fasteners to deliver a standard deviation of 0.6 and a Cpk of 8.17 is unusual in the experience of this laboratory. The data and statistics indicate that the subject coating is extremely consistent and uniform in its lubricating properties, from fastener to fastener. In the opinion of this laboratory, based on the samples coated with the subject coating and as tested, bolted joints made with fasteners coated with the subject coating should be expected to provide a highly uniform clamp load when accurately and evenly torqued."

*Testing was performed according to IAW ISO 16047:2005(E) on ten (10) M10 bolts coated by a customer or others with a blue lubricious coating, apparently a fluoropolymer. M10 nuts and square washers coated with the same blue coating were used. Equipment included a PCB 960 torque/tension system with an Atlas Copco DS7 PLC-controlled electric driver and PCB torque and clamp load transducers.

Results:

Mean Peak Torque	87.9 Nm	Mean Clamp Force	47.322 kN
Mean Coefficient of Friction	0.163	Mean K Factor (K=T/Fd)	0.186
sd	0.6	Cpk	8.17
+3 Sigma Torque	89.5 Nm	-3 Sigma Torque	86.1 Nm
+3 Sigma Clamp Load	54.621 kN	-3 Sigma Clamp Load	40.022 kN

Photos of Samples Exposed (IAW ASRM B117-18) — Salt Spray Testing

2,000 hrs

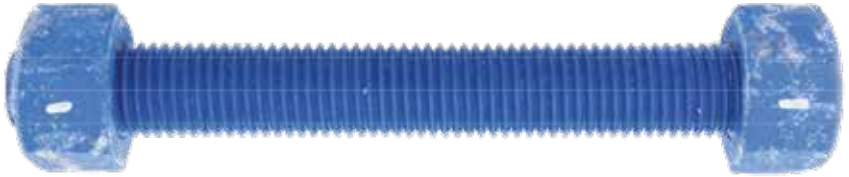


Photo — Sample #1 of top side of sample at 2,000 hour exposure — see above

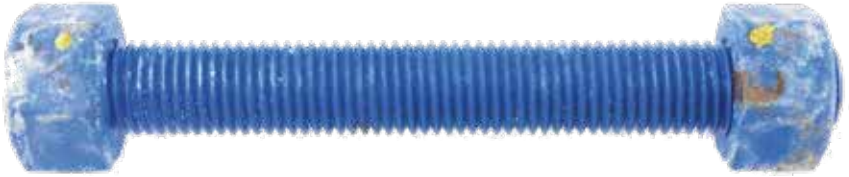


Photo — Sample #1 of bottom side of sample at 2,000 hour exposure — see above

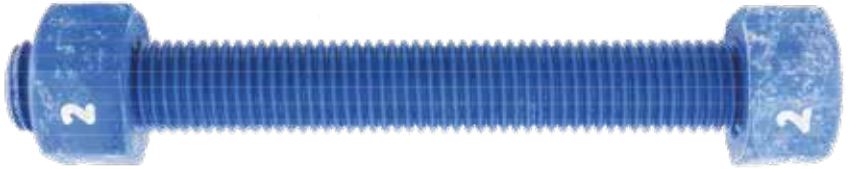


Photo — Sample #2 of top side of sample at 2,000 hour exposure — see above

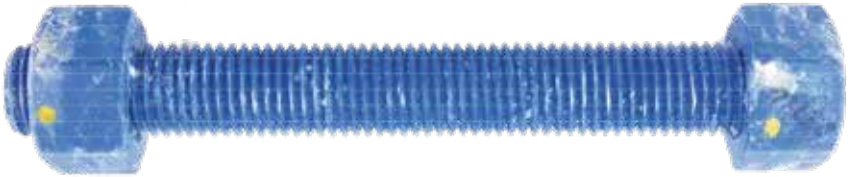


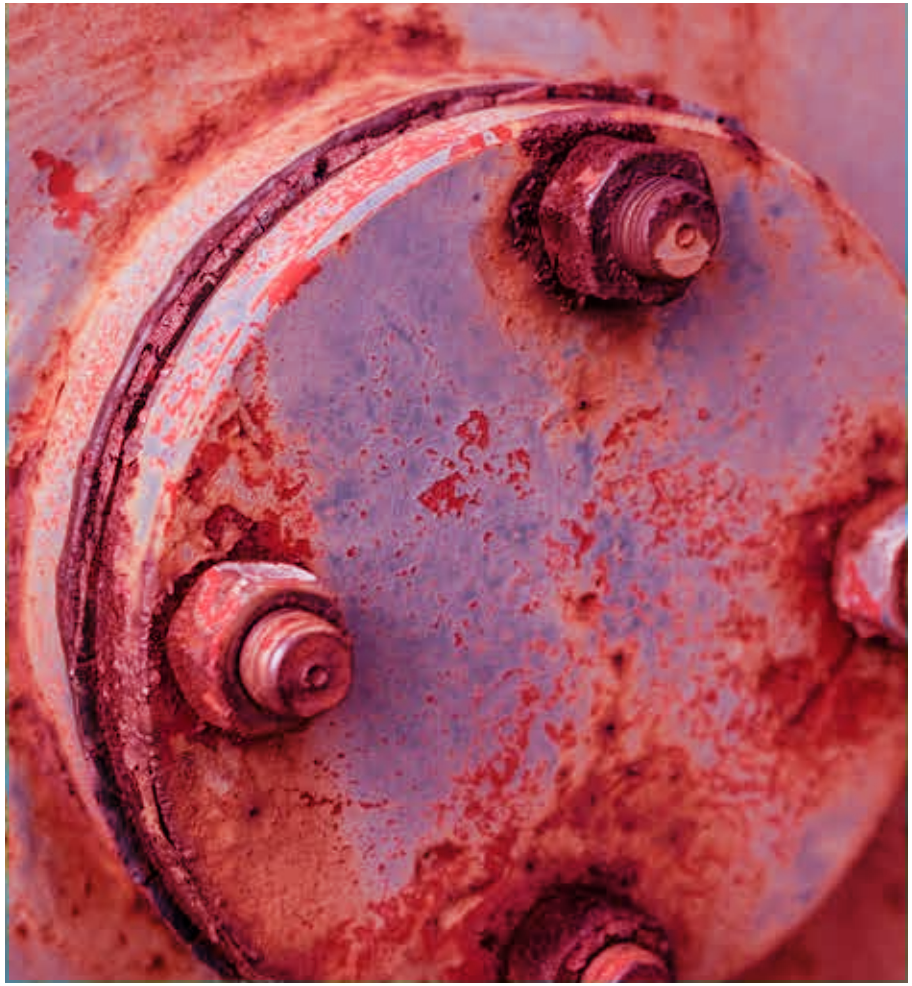
Photo — Sample #2 of bottom side of sample at 2,000 hour exposure — see above

Specifying the Right Teflon™ Industrial Coating

The challenges posed, and the damage caused by, offshore corrosion often forces oil and gas producers to weigh the efficacy of both preventive and maintenance costs. Recent experience has shown that early investment in corrosion prevention via corrosion-resistant equipment may initially entail increased costs, but in the long run can lead to reduced operational expenses and, in some cases, can help avoid major operational and environmental issues.

The only question remaining is how to select the best and most cost-effective coating for a particular environment — something able to resist corrosion for a design life of 20 years or more. The answer is to rely on tried-and-tested solutions that are backed up by years of industry-specific experience.

Perhaps this is why the high performance of Teflon™ industrial coatings makes them the natural choice in many industries. Chemours offers design engineers a range of Teflon™ industrial coatings to ensure the ideal combination of properties for each specific application. Together with its distribution and coating partners, Chemours helps educate engineers on the best selections, application processes, features, and benefits of Teflon™. In application development project partnerships with customers, Chemours experts and applicator partners are constantly finding new ways to help oil and gas engineers improve performance throughout their industry.



Explore More About How Teflon™ Industrial Coatings Can Enhance Your Performance

To learn more about Teflon™ fluoropolymers in energy, oil, and gas industries, please visit:
https://www.teflon.com/en/industries-and-solutions/industries/energy-oil-gas

To find out more about how Teflon™ industrial coatings can be used to meet and exceed your oil and gas design needs, contact us today.
Your contacts: https://www.teflon.com/en/contact