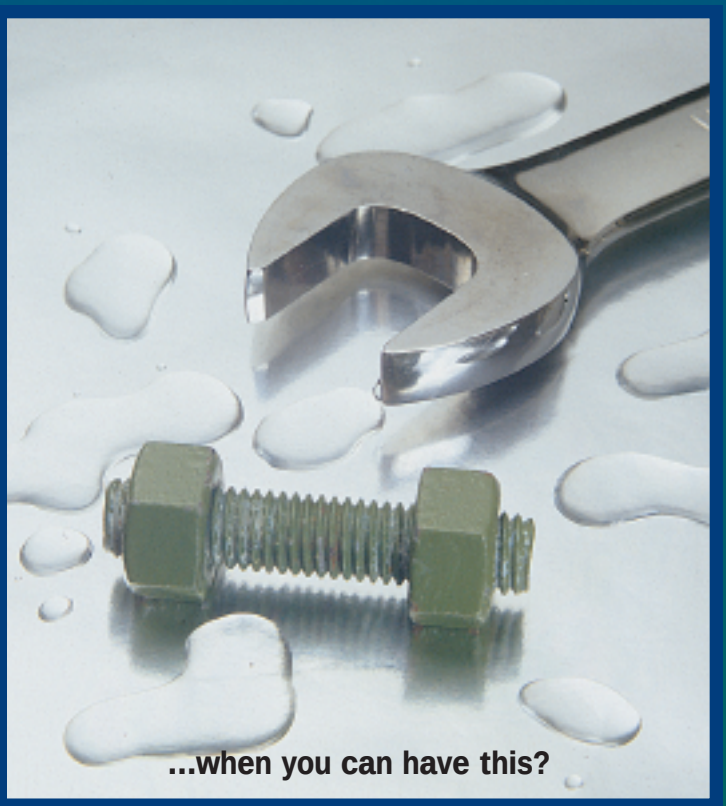
Why settle for this...



...when you can have this?

Fastener-Class Coatings from Whitford

- How to choose the right one for your application
- How each stands up to a variety of environments
- Why pretreatments / primers are crucial to success

Whitford Worldwide

Makers of the largest, most complete line of fluoropolymer coatings in the world

The corrosive elements of the environment are responsible for today's advanced coatings. Previously, fasteners were protected by electroplating, cadmium or zinc. But stringent environmental rules changed that. Further, zinc coatings cause uneven, unpredictable results.

Then, in the early 1970s, chemists developed matrix coatings based on fluoropolymers. One of the first was a product named "Xylan 1010".

What is Xylan?

Xylan is a blend of fluoropolymers, engineering plastics and selected corrosion inhibitors which, unlike conventional fluoropolymer coatings, is tailored to provide specific properties for specific applications. This gives each Xylan coating the qualities the application most demands. Among these properties are:

- Low friction (as low as 0.055).
- Remarkable adhesion.
- Unusual resistance to wear and abrasion.
- Excellent resistance to corrosion.
- Resistance to chipping.
- Resistance to the elements: weather, sunlight, salt water.
- Working temperature range from -420˚F/ -250˚C to +500˚F/+260˚C.
- Available in a wide range of colors.

Xylan's versatility is best demonstrated as a coating for stud bolts and nuts, where it provides unparalleled performance in ease of installation, resistance to corrosion and ease of removal.

While sheer economy virtually dictates the use of Xylan on standard production steel nuts and bolts, it can be used with similar benefits on stainless steel and monel — even titanium (to ease galling problems).

The Xylan coatings

There are four basic large-fastener coatings from which to choose. Here are brief descriptions:

1. Xylan 1014: This is the backbone of Whitford's products, having been used successfully for 35 years. Xylan 1014 is ideal for aerospace applications demanding service from cryogenic temperatures all the way to hot reactors operating at 500˚F/ 260˚C, and in environments from subsea to splash zone to radio antennas.

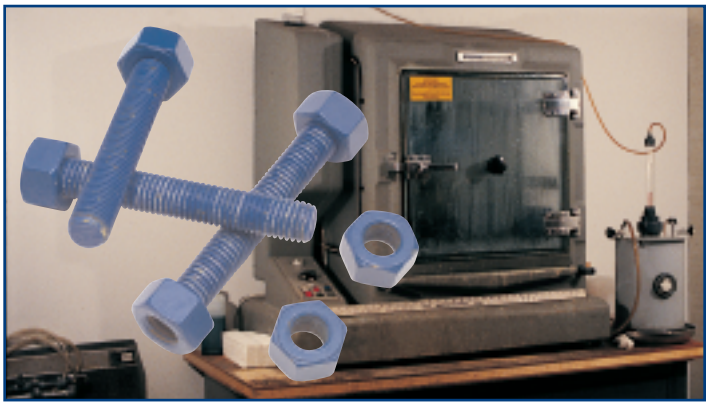
Xylan 1014 after 1,080 hours of exposure in the salt fog cabinet. Rust is minimal, the coating is still functional and the fasteners are fully serviceable.

Xylan 1014 has the widest range of temperature capability of any of Whitford's fastener-class coatings. It performs in all automotive fluids, almost all solvents and acids. It reduces make-up torque by as much as 70% and can be made up and broken out numerous times with little or no damage to the coating. Xylan 1014 has a variable cure schedule for sensitive substrates.

Note: It performs less well in caustics and UV light, and it exceeds Federal VOC limits.

2. Xylan 1400: Xylan 1400 has superb chemical and salt-spray resistance, equal to or slightly better than Xylan 1014. It performs well in caustic environments, and comes in a wide range of colors. It is used primarily in situations in which the use-temperature range is limited, and when repetitive makes and breaks are not required.

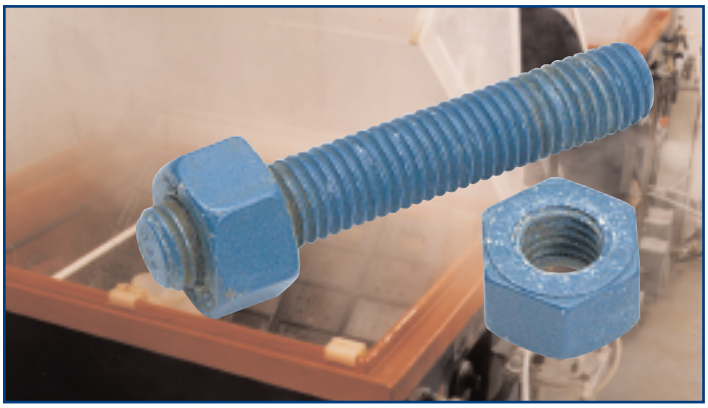
Note: Xylan 1400 does not have a variable cure schedule, and must be cured at 400˚F/



Xylan 1400 (over P-5211) after DIN 50018, 30 cycles of exposure in the Kesternich cabinet (at 2.0 ltrs SO_2). The fasteners are still functional.

205˚C for 10 minutes. It exceeds Federal VOC limits and is susceptible to UV degradation.

3. Xylan 1424: Xylan 1424 combines the performance characteristics of Xylan 1014 and Xylan 1400 into one VOC-compliant coating. (One exception: it does not have the wide range of working temperatures of Xylan 1014, performing best from -40˚F/-40˚C to +400˚F/+205˚C.)

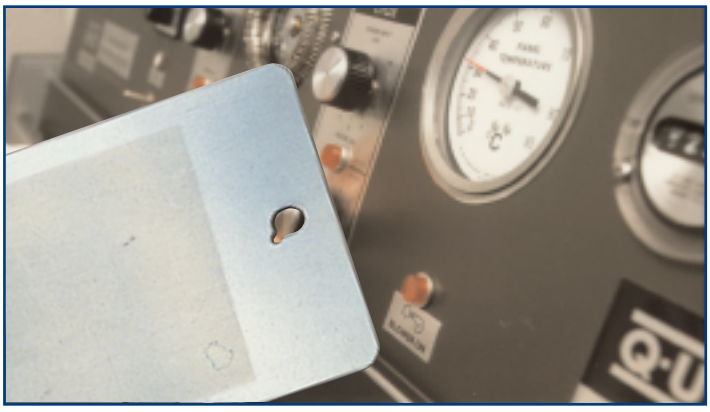


Xylan 1424 after 2,712 hours in the Salt Fog cabinet, showing 5 percent red rust.

Its chemical resistance equals that of Xylan 1400, and it can be used for repeated makes and breaks. Xylan 1424 also reduces make-up torque by as much as 70%.

Xylan 1424 is intended to replace 1014 in environmentally sensitive areas and where the end-use equipment is exposed to caustic environments. Xylan 1427 is similar to 1424 but has a corrosion inhibitor (and is intended to replace Xylan 1070).

4. Xylan 1514: This coating is designed for applications which demand superior resistance to UV and/or decorative appearances. Xylan 1514 contains sufficient lubricant to facilitate make-up. It withstands all household chemicals and is intended for use up to 250˚F/120˚C. It comes in a wide range of colors, including white.



Xylan 1514 after 225 hours QUV (ASTM G-53) exposure. The coating shows only a 5% shift in gloss.

Note: Xylan 1514 is not recommended for repeat makes and breaks or where strong chemicals are present. It exceeds Federal VOC limits.

Pretreatment: the crucial ingredient

Xylan coatings are remarkable in their performance. Applications vary from exposure to subsea, splash-zone and refinery environments to uses requiring UV resistance. The corrosion resistance of Xylan, however, is proportional to the amount of pretreatment given the substrate.

Pretreatment can vary from something as simple as a solvent wipe or thermal oxidation to grit-blasting and the application of a sacrificial primer. The method chosen depends on the substrate material and the performance requirements of the coated part.

Important to remember is that one specific Xylan coating will not perform to the maximum in all environments. This is why Whitford “engineers” Xylan coatings to meet the user’s specific demands.

In some applications the combined thickness of primer and Xylan coating may require oversizing of nuts to accommodate the coating system.

Acceptable pretreatments and primers

• **Phosphate**: Probably the oldest and most widely used pretreatments are micro-crystalline, heat-stable phosphate conversion coatings. Phosphating is an inexpensive method of bulk-treating carbon steel prior to applying any Xylan fastener-class coating. Phosphate deposition weights should be from 350 to 500 mg/ft^2. The phosphate must be microcrystalline and heat-stable. (Good examples: Keykote # 36 and #40 from MacDermid Inc.) Gritblasting is required for optimum results.

• **Xylan 4090/P-92 primer**: Developed for use with the Xylan 1000 series (including 1014) to provide even better corrosion resistance as a thin film over phosphate, it should be used only with

the Xylan 1000 series and only to improve corrosion resistance (it has no effect on adhesion).

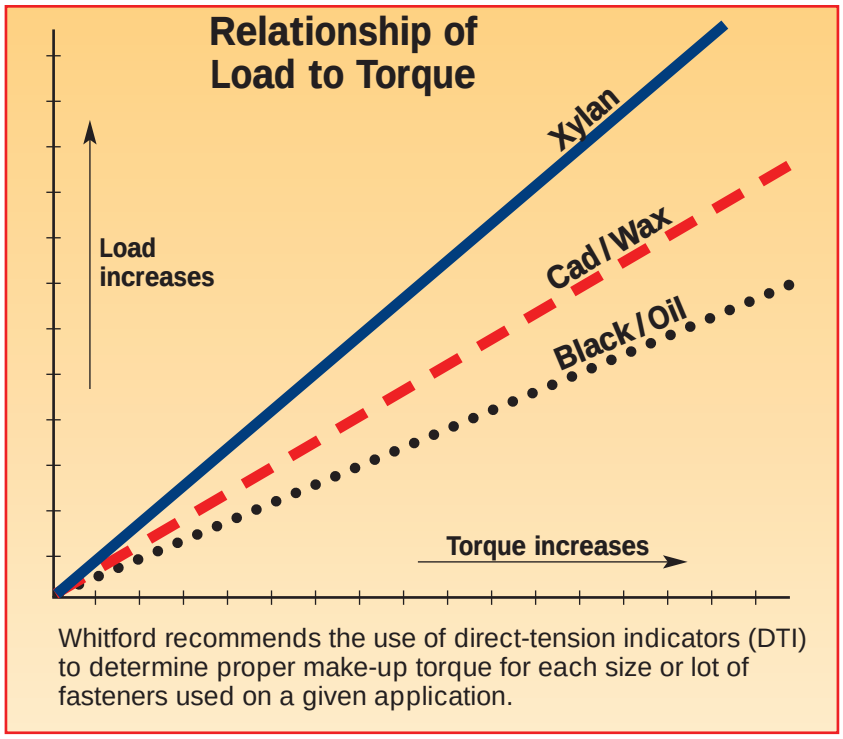
This primer is not intended for use with Xylan 1400, 1424, 1427 and 1514. Phosphate pretreatment, in combination with these Xylan coatings, will provide 500 to 1,000 hours in the ASTM B-117 Salt Fog Test and 15 cycles in the DIN50018 Kesternich Test (at 2.0 ltrs SO_2) with less than 15% red rust.

Xylan 1514 comes in the full rainbow of colors for maximum decorative and identification potential.

• **Commercial flash zinc plating**: This is the second most widely used pretreatment. 0.2 - 0.3 mil of plating is applied, etched with a modified zinc phosphate (with a 2-minute dwell) to achieve the required deposition weight, then coated with any Xylan fastener-class coating. This combination provides one of the most cost-effective ways to achieve outstanding corrosion resistance with a thin film.

Zinc platings do not provide make-up lubrication. The Xylan coating does — and it also functions as an excellent sealer. This system survives 1,000 to 3,000 hours in the ASTM B-117 Salt Fog Test and 30 to 50 cycles of the DIN 50018 Kesternich Test (at 2.0 ltrs SO_2).

• **Xylan P-5211 primer**: A zinc-rich pretreatment commonly used instead of plating to avoid hydrogen embrittlement. P-5211 is generally used when more than 30 cycles of the DIN 50018 Kesternich Test (at 2.0 ltrs SO_2) are required. Gritblasting and phosphating will enhance the performance of this primer even further. P-5211 is designed for use with Xylan 1400, 1424 and 1427.



Whitford recommends the use of direct-tension indicators (DTI) to determine proper make-up torque for each size or lot of fasteners used on a given application.

• **Xylan P-501 primer**: Designed for use when phosphate is not available, it is used with Xylan 1400, 1424 and 1427 to provide corrosion resistance similar to that of normal phosphate treatment.

• **Xylar 2**: A ceramic-metallic coating that resists oxidation at high temperatures and has long-term resistance to salt fog, it can also be used as a stand-alone coating or as a sacrificial primer for all of Whitford's Xylan fastener-class coatings.

Xylar 2 performs best when tolerances permit >1 mil (>25µm) of film thickness. It can be applied in multiple coats up to 2 mils (50µm). While it is not

always practical to apply 2 mils, Xylar 2 at this thickness has reached 10,000 hours in salt fog with minimal red rust. And Xylar 2 will withstand up to 1,100˚F/600˚C of continuous use.

A few suggestions

Whitford recommends the use of Whitford-approved fastener-class coating applicators, highly trained experts in the application of pre-treatments, Whitford primers and coatings (call your Whitford representative or Whitford for a list).

Further, with today's emphasis on quality (such as ISO 9000), Whitford urges that all end users ask for and keep a record of the lot number of the Xylan coating used. This, with the fastener certification document, ensures traceability.

For more information, contact your Whitford representative and ask for Whitford's "Guide to Industrial Products", our "How to Reduce Friction with Xylan" and our paper on "9 Dangerous Misconceptions about Xylan Coatings".

Examples of the Chemical Resistance of Xylan Coatings

Chemical	Xylan 1014	Xylan 1400	Xylan 1424
HCl (concentrated) at room temperature(1)	Severe blisters, rust	Severe blisters, rust	No effect
HCl (pH 2) at room temperature(1)	Slight marks	Slight marks	No effect
HCl (pH 2) at 125˚F(1)	Slight marks	Slight marks	No effect
NaOH (50%) at room temperature(1)	Severe failure, blisters	No effect	No effect
NaOH (pH 12.5)(1)	Severe failure, blisters	No effect	No effect
NaOH (pH 9.5) at room temperature(1)	Slight marks	No effect	No effect
NaOH (pH 9.5) at 125˚F(1)	Slight marks	Very slight marks	No effect
MEK at room temperature(1)	Slight marks	Slight marks	Slight marks
Toluene at room temperature(1)	Slight marks	Slight marks	Slight marks
Ethylene glycol at room temperature(1)	No effect	No effect	No effect
Salt spray for 1488 hours	20% red rust, adhesion loss	15% red rust, dense edge blistering	<15% red rust
Kesternich	4 cycles, 20+%, red rust, adhesion loss	30 cycles, 1% red rust, blistering	30 cycles, <15% red rust
Castrol Hydraulic Fluid at 200˚F(2)	Not recommended	Gloss decrease, no loss in coating integrity	Gloss decrease, no loss in coating integrity
W. Canning Oceanic HK-540 at 200˚F(2)	Not recommended	Gloss decrease, no loss in coating integrity, slight color lightening	Gloss decrease, no loss in coating integrity, slight color lightening

(1) = 24-hour chemical spot tests (ASTM D1308-79).
(2) = Immersion tests.

Whitford manufactures the world's largest, most complete line of fluoropolymer coatings. This includes Dykor®, Eclipse®, Excalibur®, Quantum2, QuanTanium®, Superglide®, Ultralon®, Xylac®, Xylan®, and Xylar®.

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