



## Finishers' Think Tank

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## Rust Inhibitors: Selections

Rust inhibitors are characterized by their chemical type, optimum use and related properties. Targeted protection is based on the capability of each system to meet general or specific requirements, indoors and outdoors. Factors to consider for desired rust protection include: the condition of the basis metal (porosity, surface imperfections, etc.), activity, length of storage time and relative humidity. General information is given here for a group of rust inhibitors.

### Water-based

Concentrated formulations are available in powder and liquid form concentrates. They are generally of equivalent effectiveness, based on the intended application. Most typically for steel, brass and copper alloys, the working solutions can be applied by immersion, manual wiping or by spray. There is no post-rinsing. Parts are permitted to dry as treated. The active rust or tarnish inhibitors coat the surface and are reactive to oxygen, thereby negating its activity.

Parts can be fixtured on racks, loaded in barrels or baskets or hand processed. A common application is for temporary protection. Examples are in plant storage, short-term inventory or before additional finishing or fabrication. When ready to proceed with additional surface treatments, cleaning in a warm or heated soak cleaner will normally remove the protective film. This is readily achieved in a plating, paint or powder coat line. If the parts are mass finished, as part of a process cycle, this may indeed impart surface protection. Most burnishing systems incorporate

corrosion inhibitors, driving these protective films into the metal surface. Because of related environmental requirements and discharge limitations, compliant inner transition metals, specialty surfactants and water shedders meet corrosion protection requirements. These effectively replace chromates, nitrites and amines.

### Water displacement

Formulations based on this form of corrosion protection, are solvent types, containing inhibitors, oils and surfactants. Concentrates are used full strength or diluted with specific organic solvents. Evaporation and flash point considerations require that this group of rust inhibitors be used below 100°F (38°C). Cleaned parts are water rinsed, then conditioned in the corrosion inhibitor. Water is quickly displaced from the metal surface by a protective, transparent film. This film becomes a very effective moisture blocker, by means of a mechanical barrier. Thickness and drying characteristics are unique and controlled for the degree or magnitude of surface protection required. The barrier or film may be dry-to-touch, slightly oily or non-tacky. The condition of the film determines the degree of protection and related characteristics.

*Dry-to-touch.* Thickness may vary from under 0.1 to 0.2 mil. By completely drying on the metal surface, a transparent barrier is formed. Protection is approximately 50 hours per ASTM B-117; one-month protection per ASTM D-1748.

*Lightly oily.* The film thickness approaches 0.2 mil. The film's condition allows it to flow, covering or "healing" any metal surface exposed by mechanical action (scratching, abrading, etc.). Protection is close to 100 hours per ASTM B-117; one month protection per ASTM D-1748.

*Non-tacky.* These are very thin, transparent protective coatings. The thickness ranges from 0.05 to 0.10 mil. Corrosion protection increases with increasing film thickness, up to 100 hours per ASTM B-117 to less than 20 hours; less than 20 days to approximately 30 days per ASTM D-1748.

Popular applications of these water-displacing dips follow black oxide and zinc phosphate processes. This provides Mil-spec approved corrosion protection for thin oxide coatings. The color of the black oxide finish is accentuated. Zinc phosphate crystals absorb oils. Some oils are non-conductive where the application requires this property. The solvent content of the particular oil usually determines the drying time. Oiled parts, especially small ones, can be spin-dried.

### Water emulsifiable

Formulations based on this action are oils, containing corrosion inhibitors and special emulsifying agents. The concentrate is mixed with water, forming a stable emulsion. The corrosion inhibition characteristics of the protective film vary with the oil-to-water ratio used to prepare the working solution.

Most of the water emulsifiable systems include agents providing resistance to alkaline cleaner drag (as a contaminant). This prevents breakdown of the emulsion, rendering the solution useless. These baths are used from 75 - 165°F (24 - 74°C). Increasing the temperature does accelerate the drying of parts. Dangerous solvent evaporation and ignition are avoided.

### Waxy emulsions

Waxy emulsions develop a clear, glossy, hard film on metal surfaces (finished on unfinished). The protective film provides some lubricity. Depending on solution make up, the film thickness varies from 0.1 to almost 0.5 mils. Concentrates can be used neat, or diluted with water, forming stable emulsions. Surface condition can be accomplished by immersion, spray or manual application. The bath temperature range is 70 - 85°F (21 - 29°C). Drying time is relatively short, facilitated by warm forced air or heated spin dryers. Being water-based, the wax emulsions have no flash point.

**Table 1**  
**Typical operating parameters and application**

Concentrate	Make-up	Temperature	Time, min
Liquid	1 - 10 vol%	75 - 80°F (24 - 27°C)	1 - 5
Powder	2 - 6 oz/gal (15 - 45 g/L)	75 - 80°F (24 - 27°C)	1 - 5

**Table 2**  
**Film and protection**

Oil in water (%)	Film Characteristic	Salt Spray (ASTM B-117)
5	Dry-to-touch	20 - 24
10	Slightly oily	40 - 50
20	Oily	90 - 125

With regards to environmental regulations, there is a continued driving force to reduce or eliminate VOCs as much as possible. New generation oil-based rust and corrosion inhibitors feature compliance to related environmental regula-

tions and mandates. These blends meet existing salt spray, protection requirements, as compared to the traditional oil-based systems. Proprietary formulations are in use and offer environmental and process benefits. *P&SF*

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