Cleaning

There are many tests to determine cleanliness. The most widely used is the "water break free" test. This test is a visual observation of whether water fully sheets over the clean part or draws away from portions of the surface (like water on a waxed car). Other tests may include wiping with a white cloth, alcohol drop tests, or other more sophisticated laboratory testing like coulometry (organic soil is burned off the substrate and measured).

Phosphating

The generic term "phosphating" is a process where an acid attacks the metal of the work piece and re-deposits a material that is a combination of the metal substrate (and other metals - like zinc) along with phosphate. This process creates a surface that is tightly adherent to the base metal, has more surface area, provides improved corrosion inhibition, and helps the powder coating stick better. It provides a good coating base so the finished part has increased usable life.

The process of phosphating aluminum and steel parts is typically listed as a conversion coating because the process involves metal removal as part of the reaction. However, it is not like anodizing or black oxide in that the phosphate coating is actually a precipitation reaction. The final surface is a layer of very fine phosphate crystals adhering to the surface of the metal. For paint and powder coatings, a phosphate coating has two main functions. First, the coating provides improved paint and powder coating adhesion since the phosphate crystals act as organic coating anchoring sites. Second, the phosphate layer acts as a corrosion barrier should the organic coating get scratched. In rust creep testing, the rust creep is reduced when phosphate is present under the paint layer or powder coat layer compared to no conversion layer under the organic coating.

Phosphate can be used as a stand-alone coating for other purposes such as lubricity in parts forming but the other functions are beyond the scope of this report. The most common phosphating chemistries are iron phosphate, zinc phosphate, and manganese phosphate. There are also other phosphating chemistries such as Plaforizing™ which are non-traditional in their chemistry and application since they are single step and typically an organo-phosphate that react with both the organic contaminants and the metal surface.

The main thrust in recent years for improving the phosphate process is to reduce the temperature requirements for the phosphate bath. Some chemistries have been developed that work well at room temperature. In general, there has been a trend from high temperatures, 90 F to 200 F, to much lower temperatures, 70 F to 140 F, resulting in energy savings.

Drying

Part Drying It is important to define the goal or goals in the process of drying parts after the finishing operation. Is it to prevent rusting before some additional steps, to avoid water spots resulting in some cosmetic problems, or is it to provide dry parts for the next operation?

Water spotting: The easiest way to prevent water spotting is with the use of DI (deionized) water in the final rinse. The water spots are typically due to minerals in normal process water and can be eliminated by removal of the minerals. A second method that at least will minimize water spots is with an air blow-off process to remove the water droplets before they have time to dry on the parts. This method will be very dependent on part geometry and part orientation on the racks. If the air cannot reach certain areas on the parts due to geometry or if parts block each other then the spotting may still occur in those areas.

The Drying Process: Ideally the method or methods employed to dry parts should be as energy conservative as possible. For example, high pressure blowers should be used instead of compressed air since the electricity costs are much lower for blowers than compressors. As a side note, the risk of getting air carried contaminants on the parts is higher for compressed air than with blowers.

Hot final rinse: One of the easiest methods of drying parts is with a hot final rinse using DI water. The parts will flash dry if the part geometry does not have any areas allowing water to puddle. This method requires energy to heat the water but totally eliminates the need for any hot air drying.

Air drying: There are two means of drying parts with air, which can be used in conjunction with each other or independently.

High velocity air: Primary purpose is to knock the water off the parts rather than dry the water off the parts.

Heated air (convection drying): Primary purpose is to evaporate the water off the parts. These means that the parts have to warm up in the heated air to effectively evaporate the water Combination.

Hot and high velocity air: This combination allows the parts to dry rapidly without the necessity of heating the parts up to cause evaporation. The large water droplets are knocked off the parts and any residual fine droplets are evaporated.

Infrared drying Infrared (IR): is a line-of-sight method of drying parts that is energy efficient compared to convection heating of parts. The IR light is rapidly absorbed by the surface of the part resulting in a high surface temperature. Water remaining on the part surface is rapidly evaporated without the need for the whole part to reach a high enough temperature to cause evaporation. Since the process is line-of-sight, it is best used for either thin parts that allows rapid through-heating of the part and part cavities, or best used on flat parts such as panels which have simple geometries.