GUIDELINES FOR CLEANING STAMPED METAL PARTS

One of the most critical operation in the metalforming process is the preparation of the formed metal part for a finishing operation. Whether the plate is to be plated, painted, chromated, or E-coated (electrostatically applied coating), the quality of the final finish depends on the effort expended to achieve a proper cleaning that is compatible with the finishing process. Cleaning of formed metal parts has become extremely important so much so, that automotive companies have implemented stringent testing programs to qualify a product on a) how it washes of and b) the quality of the part after it is welded, primed, and painted. The selection of the cleaning process is usually dictated by the residue to be cleaned, the metal and the degree of cleanliness required. Since the selection of the cleaning process is based on several variables, a thorough understanding of basic cleaning mechanisms is needed. The following is a review of the most widely used methods for cleaning stamped and drawn metal parts, and the advantages and disadvantages of each method.

Solvent Vapor Degreasing

An effective method for cleaning stamped and drawn metal parts. There are many types of vapor degreasers, but all operate on the same principle. When cold parts are placed in the vapor zone of the degreaser, the solvent vapors condense on the part, dissolving oil and other contaminants. The cleaning action continues until the temperature of the part reaches the temperature of the vapor, then condensation stops. The dirty solvent drains off, leaving parts clean and dry, and ready for finishing.

A basic vapor degreasing is an open top tank with a heat source in the bottom to boil the solvent, a set of condensing coils, and a water jacket around the upper section to help condense the solvent vapors. There are two variations of the basic unit. One is an open top unit in which baskets or racks filled with parts are manually lowered into the vapor zone, left for a period of time, and removed when the parts are clean. The second variation is a conveyorized unit in which parts are mechanically carried through the vapor zone. Cycle time is usually ten minutes or less.

There are four chlorinated solvents typically used for vapor degreasing. Each solvent has advantages for special applications.

Trichloroethylene

This solvent operates at a boiling point of 188 °F and is commonly used to remove semi-cured varnish, paint films, heavy resins, and buffing compounds. This solvent is a suspected carcinogen.

Perchloroethylene

Because if it's high boiling point of 250 °F, this solvent is used for removing high melt waxes and heavy oils. This solvent is also a suspected carcinogen.

Methylene Chloride

Because of it's low boiling point of 104 °F, this solvent is commonly used to remove oils from temperature sensitive parts. It is also a suspected carcinogen.

1,1,1-Trichloroethane

This solvent is rapidly becoming more common because of lower toxicity levels, lower boiling point of 165 to 170 °F, and lower consumption levels. This solvent is commonly used to remove oils, waxes, greases, and lubricants.

Overall, vapor degreasing is simple, effective cleaning method for stamped and drawn metal parts. Typically, parts that have been stamped with straight oil require vapor degreasing to sufficiently remove oil for finishing operations. Parts stamped and drawn with water-soluble lubricants, like MILFORM™ or MILDRAW™ products, do not require vapor degreasing due to the incompatibility of the water and solvent. However; parts that are stamped with MILFORM™ or MILDRAW™ products and allowed to sit for a period of time could require vapor degreasing to remove MILFORM™ or MILDRAW™ product residue. This is due to the water evaporating and leaving a concentrated form of residue on the part.

Disadvantages of vapor degreasing are directly related to the safety and environmental problems associated with the solvents used. The Environmental Protection Agency has become very restrictive with recycling and hauling away of the chlorinated solvents. Most chlorinated solvents are suspected of being carcinogenic, and operator exposure limits to vapors are highly controlled by the Occupational Safety and Health Administration. Further restrictions on the use of chlorinated solvents from OSHA and the EPA are expected on a regular basis.

In-Line Spray or Immersion Cleaning

The most common method of cleaning stamped metal parts. Both systems use a water based cleaner that is either acid or alkaline. This type of cleaning is used to remove stamping and drawing fluid residue prior to a finishing operation. Most MILFORM™ or MILDRAW™ product residue washes easily in this type of system. Immersion alkaline or acid cleaners are mainly used prior to plating, anodizing, and chromating. Spray alkaline or acid cleaners are normally used prior to painting operations.

In addition to the type of cleaning system used, there are other physical and operational factors that affect cleaning. Proper application of the following factors optimize cleaning effectiveness.

Maintenance

In an aqueous cleaning process, the removal of residue is due to detergency rather than solvency. Residues are removed by chemical displacement, rather than being dissolved from the surface of the part by the cleaner. After displacement, the residue may emulsify with the cleaner, it may separate or settle as sludge, or it may rise to the surface. For these reasons, the cleaner is constantly being depleted of it's detergency, and needs to be replenished with new cleaner solution at regular intervals. Many cleaning problems disappear when the cleaner is properly replenished and maintained.

Time

The length of time that parts remain in the cleaner solution is significant. The longer the dwell time, the more effective the cleaning. Heavy residues, oils, and waxes require a lone enough soak, or spray time, to work through the layers of residue. Time cycles vary depending on the residue load and the type of residue on the part to be cleaned.

Temperature

The chemical activity of a cleaner is a direct function of temperature. For each degree Fahrenheit increase in temperature, there is a 2.6% increase in chemical activity. The higher the operating temperature, the better the cleaning. Typical washing systems and alkaline cleaners work best in a 140 °F to 160 °F range. New technology has developed low temperature cleaners. However; when the residue load is heave or the residue consists of compounds that need heat to facilitate removal, low temperature cleaners are inappropriate. Higher temperature cleaners work best in removing MILFORM™ or MILDRAW™ product residues.

Concentration

The rate of cleaning is a linear function of the concentration of alkaline or acid cleaner. Proper concentration levels must be maintained to guarantee effective cleaning.

Agitation

Spray cleaning can more effective than immersion cleaning because of pressures and volumes aiding in residue removal. Immersion with ultrasonics, or electrolytic action, is more effective than normal immersion due to increased surface activity.

Rinsing

The importance of thorough rinsing after cleaning cannot be overstated. Rinsing is a dilution process, and it's function is to remove water-soluble material from the surface of the part after cleaning. Most water-rinse stations include some type of rust inhibitor to protect the metal part between finishing operations. Any carryover of residue will have a negative effect on subsequent operations.

All contributing factors must be balanced to optimize the quality of the finished coating of the finished part. Again, these factors include a) mechanical characteristics of the cleaning system, b) type and composition of the cleaner, c) it's operating parameters, and d) the composition of the lubricant used to stamp and draw the metal part. Alkaline cleaners are being formulated to be compatible with all types of water-soluble oils, semi synthetics and synthetic lubricants.

There are a wide variety of companies that manufacture washer equipment and washer chemicals. Ranshoff, Cincinnati Washer, and Donaldson are three manufacturers the build similar types of equipment commonly seen in stamping and drawing plants. Betz and Parker are two of the better-known washer chemical manufacturers. Both companies have worked with Milacron in troubleshooting, and in finding alkaline cleaners that work specifically in removing MILFORM™ or MILDRAW™ product residue.

A metal can use a lubricant available in the marketplace. Plating and painting problems, however, can be avoided if the basic principles of cleaning the stamped and drawn metal parts are followed. In the near future, more and more metal stampers will be looking for alternatives to vapor degreasing, and straight oils or other compounds that require a solvent to remove the residue. The reasons will be for health and safety factors and for economics. The combination of alkaline and acid aqueous cleaners and water soluble lubricants, like MILFORM™ or MILDRAW™ products, will be some of those alternatives. ■