The Right Start to a Perfect Finish

Basic concepts and considerations for rack design.

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Historically, metal finishing racks have come a long way in their design. The crudest form of racking is simply a wire twisted onto the part. With the production and quality requirements of today, an expensive piece of copper wire will not suffice. The parts must be presented to the anodes with consistency to ensure visual and measurable quality requirements. For decorative automotive finishes of today, require custom racking. In this paper, I will review some basic concepts for rack design and maintenance.

The most important aspect of any rack is the design. Without the proper design, one cannot expect to obtain the optimal productivity that the process is capable of achieving.

There are many factors that come into play when designing and building racks. In this paper I will discuss: Equipment Manufacturers, Dimensional Restrictions, Weight Restrictions, Part Presentation and Spacing, Rack Material, Manufacturing Techniques, Optimized Designs, and Selecting a Supplier.

EQUIPMENT MANUFACTURERS

There are several automatic equipment manufacturers in the market and each may have distinct methods of attaching or mounting a rack. The two most common lines manufactured are the return line and hoist line. Regardless of the equipment, the first consideration is how the rack will hang on the cathode.

Return lines are typically a “Carrousel” design. The racks will travel from station to station in a circular movement. The racks are usually similar in dimensions and will carry, as close as possible, the same surface area. Manufacturers of return-type equipment use brass alloy castings, or hangers, to carry the current to the rack.

Hangers are different; what needs to be known to ensure a perfect fit is the center-to-center dimension, the area where the rack hangs on the casting. Castings are mounted on the machine and the racks hang on specific notched areas of the casting. If a rack does not hang properly onto the casting, it cannot be assured of the required current flow, and one runs the risk of the rack not having the appropriate clearance as it moves from station to station.

The advantage of a hoist line is the racks can be designed to have varying center-to-center locations and can vary in overall width, allowing several racks to be loaded onto a flight bar. Hoist lines typically do not use castings and the racks are simply hung onto the cathode bar.

DIMENSIONAL RESTRICTIONS

The primary dimensional restrictions (the work envelope) are the overall height, width and length of the rack and the placement of the parts. These specifics must be known *before* a useable rack can be fabricated and successfully perform.

The overall height is measured where the rack hangs on the hanger or flight bar to the bottom-most useable space in the process tanks. One of the mistakes made when taking these measurements is neglecting unseen any piping in the bottom of the tank. The other common mistake is not taking into consideration obstructions on the top of the tanks when the racks are moved from tank to tank.

The length is the useable left-to-right dimension. This is important on both a return and hoist line. For a return line, typically one rack will be set into a single tank for rinsing. If the width of the rack is too wide, then rack and parts can be damaged from hitting or scraping the walls of the tank. On a hoist line, racks with the wrong width will not allow the maximum number of racks on a flight bar, resulting in lower overall production.

WEIGHT RESTRICTIONS

The manufacturer has designed the machine hoists systems to handle specific weights which will include the racks and the parts. This information must be known and may restrict the number of parts that can be processed on a work bar. This is not typically a problem, but it can be if particularly heavy parts are being processed. Also important is the human weight restrictions in the loading/unloading segment of the process.

With racks that are to be handled off line, the rack designer will need to know what the weight limits will be as required by the customer's safety and health administrator.

Many situations require parts to be loaded onto the rack and then hand carried to the plating line. The rack supplier must ensure that the total weight of the rack and parts do not exceed the maximum restrictions. Keeping the weight manageable will avoid possible lost time, injuries and worker compensation claims.

The use of aluminum in the framework of the rack will eliminate the weight that copper adds. (This will be discussed later.)

PART PRESENTATION AND SPACING

Most plating processes are reliant on proper positioning of the parts, particularly during the plating process. Consideration of the part configuration is vital when planning how it is placed on the rack contacts. If a part is cup-shaped, the part would not rack with the cup facing up or down. The desired positioning would be such that the solutions flow freely in and out of the part when being moved from tank to tank.

Maximum exposure to the anodes must be achieved. For the same cup-shaped part, the open end of the part must face toward the anodes, especially when plating inside of the recessed area is a requirement. When plating wheels, one would not face the outside diameter of the wheel toward the anodes. It is preferable to position the face of the wheel toward the anodes and configure the rack to locate the rim as close as possible to the anode to allow for proper thickness and plating distribution. Even with these design concerns, some recesses might not plate properly. In these cases, an auxiliary anode must be considered.

AUXILIARY ANODES

Plating inside of recessed areas, such as wheels and step bumpers, is difficult and sometimes impossible to do without the use of an auxiliary anode. The determination is at times easy to make and at other times not so simple. Experience and knowledge of the process is normally adequate to make the decision. At times it is decided to use an auxiliary anode due the part simply not plating to requirements or specifications.

Auxiliary anodes should be made adjustable and easily removable to facilitate loading, unloading and replacement. The auxiliary anodes must be secured to the rack using insulated material so the anode does not cross the cathodic current path with rack.

Auxiliary anodes can be made using lead, steel, stainless steel, nickel, or coated titanium, and the choice of anode material is process specific. For nickel/chrome processes, it is best to use auxiliary anodes made of titanium that is platinum plated, platinum clad niobium mesh. During the past few years, platers have had success using an iridium oxide coating on titanium. This material is less expensive than platinum and normally lasts longer before recoating.

ROBBERS AND SHIELDS

Robbers are used to prevent burning in the high current areas of the part being plated. Robbers also have other names such as “thieves” and “burning bars.” Parts with sharp edges or points at times need special care. The current flow to these areas is typically excessive and the parts have a tendency to burn. By placing a robber which is connected to the cathode and positioned near the high current area of the part, the robber will pull the plating away from the hardware, resulting in a part that is free of excess plating and burning.

Shields are another option to feather the current path to the part. In this case, a shield is used instead of a robber for the parts on the outside border of the rack. A shield can be made of a non-metallic material and is used to cover up high current areas, shielding the plating flow to high current areas of the part. This is an effective and lower-maintenance alternative to robbers.

RACK MATERIAL

In selecting a material to build a rack, the preferred metal is copper. To carry the necessary current throughout the rack and distribute it to the parts, nothing is more conductive than copper.

Some suppliers have been known to use steel in an effort to “price down” their product. This should be avoided at all cost. Steel only carries 12% of the current for the same size in copper.

Aluminum has been successfully used even though it only carries 60% of the current as compared to the same size material in copper. Normally when weight is an issue, aluminum is a logical choice.

Stainless steel is used throughout the industry as the preferred tip material, and alloys 301/302 and 316 are used. Stainless steel offers adequate current carrying capacity in most cases and is resistant to strippers that are used when the racks are cleaned.

MANUFACTURING TECHNIQUES

To protect the metallic framework of the rack from the chemistry of the plating line and to insulate the metal rack components from plating, the supplier must coat the rack in a good PVC (plastisol). All plastisol are not created equal. Some rack suppliers cut corners by using bottom-shelf plastisol and this is not obvious when the racks are delivered. The rack looks as good as a higher-priced competing rack. The problem will evolve and is noticeable when comparing the life of the plastisol. Premature degradation of the plastisol will create cracks in the coating, causing solutions to be transferred from tank to tank and contaminating process baths. It will also cause acids to reach the copper framework and eat away at the rack material. Coating failure and damaged framework will cost more in the end due to early repair of the rack and replacement of the damaged framework. One should never purchase racks based upon cosmetics alone, as much can be hidden under the plastisol. Be sure that your supplier uses good quality material from the metals to the plastisol.

Building a plating rack is not rocket science. For the most part, all rack suppliers use similar methods of manufacturing — that is, we cut, drill, punch, bend, rivet, bolt, and coat. The difference from a good supplier and an “adequate” supplier is quality of construction.

The preferred method of constructing the rack frame is to bolt the pieces of the framework together. There are occasions when the customer requests that the framework be soldered at the joints. This does improve the integrity of the joint by fusing the two pieces together, but there is a question if it improves conductivity.

Tips can be bolted or riveted in place on the rack. Either method works fine for smaller tips; larger tips will require bolts. Rivets do offer a tighter contact in overall pounds per square inch. One may twist the bolt head off trying to match the "psi" of a rivet.

Racks do have a life expectancy. Over time, through use, tips will break, the plastisol will break down, or your machine will crash, making a pretzel out of your once-square rack. When one returns a rack to your supplier for rebuilding, one should expect more than just repairs. On a rack that has been used, resulting in the tips being broken from stress, the rack supplier should replace all of the existing contacts with new ones, thereby turning a repair into a rebuild. This normally costs a little more, but what good is it to have a few tips replaced only to have a few more break within a month after getting the rack back after repair? The first tips broke due to stress, and the rest of the tips are also stressed. Finishers should never have only the broken tips replaced.

One method to save money is to consider replaceable tip racks. These are made to allow the broken or worn tips to be replaced by the customer without the expense of sending in the frame. Extra tips can be kept on hand for use as required.

OPTIMIZED DESIGNS

Your supplier would like to sell you as many racks as he can, but in most cases this is just not necessary. Competent and experienced rack suppliers will design the racks to carry as many different parts as possible on the same rack. By doing this you can minimize your inventory and initial costs.

Unfortunately, you cannot always optimize the rack design. One must always plan for enough in the budget to supply all the process requirements. Money not used can be returned to the account, but anyone who has underestimated a capital request knows that it is next to impossible to receive extra funding above and beyond what was previously approved by management.

There is always the human element that must be considered when designing racks, and ergonomics must always be considered. Excessive contact squeezing can cause repetitive motion injury such as Carpal Tunnel Syndrome. Gravity or push-on tips should be incorporated in contact design — when the process permits — and this will help with productivity and keep employees happy and content. It is always a good idea to rotate your people to avoid repetitive injury.

SELECTING A SUPPLIER

When selecting a supplier, one should not look for the cheapest, but rather one that offers the greatest value. In many cases you get what you pay for. After all, who goes into a tire store and asks for the cheapest tire? It may cost you less, but it will never last as long, or perform on the same level, as a better tire.

Check the present customers of the company you are considering; they can give you some insight to their capabilities. Make sure your supplier is knowledgeable of your processes and requirements. More importantly, find a company who cares about the metal finishing industry. You will know these companies through their involvement in industry-related organizations.

CONCLUSION

I have presented some basic thoughts on rack design that should help you in understanding the world of racks. The hidden message in all of this is: let a professional take care of all of your racking needs.

There is one more important message to consider: There is a secret to selecting the perfect rack supplier. Please feel free to contact me, and I will tell you the secret to finding the perfect supplier. You, too, can then discover the "Right Start to a Perfect Finish."

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