

Powder Coating in the Home Shop

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I'm sure you have heard of and seen examples of Powder Coating, but did you realize it was something you could do in your own shop? Now, because of new low priced equipment and the availability of small quantities of material, doing your own high-quality Powder Coating is a reality.

This article is based on my experience of setting up a small facility to powder coat parts I fabricate for both hobby and business. I will outline the equipment you will need, and some of the techniques that are used.

Basically Powder Coating is the process of applying a dry paint (powder) to a piece of metal and baking it in an oven where the paint liquefies and cures. The powder is fairly coarse, about 1200 grit or so. There are two types of powder coat, Thermoplastic and Thermosetting. The Thermoplastic process uses a material that melts when it is heated, hardens when it cools, and can be re-melted. Thermoplastic is only used for special applications, and will not be discussed in this article. The most common Powder Coating is Thermosetting. In this case the heat is used to cure the material. Once cured, the coating can stand-up to rather high temperature without melting or decomposing. Some Thermosetting coatings can even be used to coat barbecue grills and exhaust headers.

The powder is "sprayed" on the part using a gun that produces a soft fog of powder. Since the gun operates at low pressure, 10 to 15 psi, you don't need much of a compressor. (You do need to make sure your air is as dry as possible) To make the powder stick to the part, the powder is given an electrostatic charge of high-voltage. The guns discussed in this article have a power supply that produces about 10,000 volts at very low current. Just before the powder leaves the gun, it passes by some corona wires that give the powder its charge. It's amazing how strong this force is. If you bring the gun too close to the part, the part will actually move toward the gun because of the electrostatic attraction.

Some of the equipment you will need can be built in the shop, or bought used in places like eBay. The first thing you need is a good way to clean the metal. I use a



Powder Coating Oven

sandblast cabinet with 70 grit aluminum oxide as the abrasive. Sandblasting the parts gives a good “tooth” for the powder coat to bond to.

You will need some sort of spray booth, or at least a way to spray the parts without getting powder all over the shop. I built my booth using plywood. The fans are surplus muffin fans used for cooling electronic equipment. For filters, I use a 2” thick furnace filter followed by a bag filter I bought from Grizzly tools. The furnace filter will not stop the powder, but the 3 micron bag will. I mounted a small gear-head DC motor in the top of the booth. This motor can be turned on to slowly rotate the part while I am spraying it. This allows you to use a much smaller booth because the spray gun does not have to swing around the part. Make sure you make a good grounding system for your booth so that it will be easy to ground the part during spraying. A poor ground will prevent the electrostatic system from doing its job.

I use a small commercial oven that was designed for powder coating, but I understand a conventional household oven can be used as well. Keep in mind that once the oven is used for curing powder coat, it should never be used for cooking food.



The Chicago Electric Gun and some Powders

The most important thing is the powder coating gun. Chicago Electric (Harbor Freight) and Eastwood both make inexpensive powder coating guns that come complete with the high voltage power supply used to make the powder stick to the part. Harbor Freight sells two models of powder coating ovens, the smallest is just over \$100, and the larger one is about \$400. Use the supplier list, at the end of the article, to help you find deals on the equipment you need.

Lastly you will probably want to get some high-temperature plugs and masking tape. The special high-temp tape will withstand the 400 degree temperatures without peeling on leaving a sticky mess. In fact you can use this tape to mask areas where you do not want color, then peel off the tape and do a clear coat without having to re-clean the part. The plugs look like test-tube plugs, but are made from silicone. They are used to cover critical holes where you do not want the coat to go. Powder coatings are applied with thicknesses of 1.5 to 3 mils, so you can imagine what that can do to hole clearances.



Products used for High-Temp masking

The powder is available in several different formulations. The main types are Epoxy, Polyester, and Acrylic. There are also mixtures of these technologies called Hybrid. Epoxy coatings are great where chemical resistance, such as the inside of a tank, is important. But they are not well suited for exterior use because epoxies tend to chalk when exposed to ultraviolet. Epoxy/Polyester Hybrids improve some of the characteristics of epoxy, but will still chalk under high ultraviolet.

The most common material I have seen is called Polyester TGIC. This material was developed in Europe and is a hybrid of Polyester and an epoxy-like material that is not susceptible to chalking, but has some great characteristics. The TGIC produce a very high viscosity melt that flows very smooth and has good corner coverage. It also allows lower temperature and shorter curing times.

There is a very wide range of colors, effects, and surfaces available. The Mirror-Gloss finishes from Columbia Coatings is incredible. They also have a chrome that can then be clear coated or covered with a translucent candy color that looks fantastic. The Mirror Clear finishes come out looking like the part is covered in glass.

Step by Step Powder Coating

This is the part we have chosen as an example. It needs some cleaning, and we will have to make sure to protect the threads from the powder coat.



1. The first step is to clean and prep the part to be coated. Since the dry powder does not contain any solvents that help to displace oil, the work piece must be free of oil deposits. Cleaning the piece with a good water based de-greaser works well. I like the “Tubing Cleaner and Degreaser” sold at Triple-S steel. It is designed for cleaning the rust preventative/lubricant from mechanical tubing. Simple Green also works for this purpose. I generally sand blast the part with 70 grit aluminum oxide. This removes loose rust and gives the surface a good texture for the powder coat to adhere to. After sandblasting, I again wash the part to remove any grit, and then treat the part with either a Phosphate or Chromate conversion coating. The conversion coating is not absolutely necessary, but it never hurts.



Sandblasting with Aluminum Oxide grit

2. Mask the places where you do not want coating. This step can also be done before sandblasting, but still make sure the piece is grit-free before spraying the coating.



The part has been cleaned and plugs inserted to protect threads

3. Pre-heat the part to prevent later out-gassing problems. This step helps drive out water and oils that are traps in pores in the metal. If you preheat the part to the same temperature as you plan to cure the coating, it is unlikely that you will have any problems with trapped contaminants. The step is not necessary if your part is made from billet or sheet and there is no danger of trapped contaminants.

4. Spray on the coating. It takes a little practice, but the goal is to produce a coating with a film thickness of 1.5 to 3 mills (.0015" to .003") The easiest way to do this is to hang the part on an "S" hook while spraying. Avoid getting the gun too close to the part, because you can generate a spark that can ignite the powder. Most powders are coarse enough that ignition is un-likely, but it can happen. If I have parts with a lot of recessed areas to be painted, I pre-heat the part and put it in the spray booth while it is still hot. The recessed areas tend to be shielded from the static charge (Faraday Cage effect). I start spraying the recessed areas with the high voltage turned off. This allows me to get in close and the powder will stick to the hot metal. After getting the recessed areas, I switch the high voltage on and do the rest of the part.



The electrostatic charge makes the powder stick to the part.

Powder is put on pretty heavy since only one coat is needed.



5. Cure the coating. Most coatings, of the Polyester TGIC type, cure at 380 degrees for 20 to 25 minutes. The base metal must be at temperature before curing can start, so if you have a very thick section, the curing may take longer. If you watch the part while it is curing, you will see the powder melt and convert into a thick syrup and flatten. This is an indication that you will be getting a very smooth surface on the finished piece.

6. Remove the piece from the oven and allow it to cool.



The part is in the oven for curing

The Finished Product



Some notes and troubleshooting tips:

As stated above, pre-heating can make it easier to get the powder to stick into recesses and hidden areas of the part. I have also had problems getting the powder to stick on the second coat of a two-coat process. When putting a translucent candy color on top of chrome coating, the chrome coating acts as an insulator so the electrostatic attraction is not as good. To get around this, I make sure I am ready to spray the second coat as soon as I pull the piece from the oven.

When applying multiple coats, be sure to read instructions that come with your powder. Most topcoats require that the first coat be only partially cured before the topcoat is applied.

Make sure you have a good ground on your work piece. I mistakenly connected the ground to the masking tape, and contact was not made. The finish was lumpy, and I couldn't figure out why until I realized what I had done. Then I had to strip the part and start over.

Stripping the parts can be difficult. Sand blasting will not remove powder coating. This is because the powder coating is very tough, much tougher than the surface of your part. So if you try to sand blast the coating off, you are likely to damage the part. Chemical strippers will remove powder coating. Again, powder coating is very tough, so you must find a stripper that will work. Home Depot sells a heavy-duty stripper for industrial finishes including powder coatings, but it takes a long time. Industrial strippers made for removing aircraft paint are supposed to be pretty good for powder coat.

Cleaning the gun is easy if you have a good spray booth. Since there are no liquids involved, cleaning is as simple as blowing the powder out of the parts of the gun, and allowing the booth to capture the powder. It takes about 5 minutes to clean the gun and re-fill with another color.

When spraying the powder or cleaning the gun, you should wear a good quality filter mask. Use the type designed for spraying industrial finishes. These have very fine filters and do an excellent job of stopping the fine dust from being inhaled. Although there are virtually no VOC's with powder coating, the dust can be a hazard.

Vendors for Equipment and Supplies

Guns

Harbor Freight sells the Chicago Electric Model 42802. This is the gun I use. They cost \$79, but you can find them on sale. Remember, if you find it cheaper on their web site, print out the page and take it to the store. They will sell it at the web price, but they do want the printout for their records. Web - www.harborfreight.com

The other gun that is popular is the Eastwood Model 10198 Hotcoat Powder Coating Gun. It is about \$100. I've never used one, but it looks like it would be in the same category as the Chicago Electric gun. The main difference is that the Chicago Electric has its hopper at the top, where the Eastwood has its hopper below. Eastwood also has a more deluxe gun it sells for \$700. One nice thing about this gun is the high voltage power supply is built into the gun, and can be adjusted up to 25KV. This would be helpful when using powder that requires a topcoat. Web – www.hotcoat.com

Powder

Both Harbor Freight and Eastwood sell powder, but you can find better deals. I buy most of my material from Columbia Coating. On the web you will find them at www.columbiacoatings.com. You can also call them at 866-388-7730. They have powder in small quantities, as well as other supplies such as masking tapes and plugs. Another supplier is Pendry Powder Coating. They can be found on the web at www.pendrypowdercoatings.com. Pendry carries similar coating prices and supplies as Columbia. Pendry does have some special metal-flake additives that look like they would be fun to use.

Ebay is also a good place to buy powder. I have purchased 5 pound lots of surplus powder for only \$10.

Ovens

I have a Chicago Electric Model 46300 powder coating oven. It is sold by Harbor Freight and their affiliates. It works quite well, and I think it is a pretty good unit, especially for the price (\$400). I bought mine as damaged merchandise from a seller on eBay. It was \$200, and all I had to do was knock out some dents and reposition the fan.

Commercial Powder Coat ovens are expensive, so here is a chance to show off your ingenuity. Electric household ovens would probably work pretty well. I think it would be best to put a metal shield over the heating element to prevent direct heating of your parts. Adding a stirring fan would also be a good idea. A large restaurant convection oven would be perfect.

Spray Booth

I built my spray booth out of plywood. It is 24" wide, 30" high, and 20" deep. I used a 20x25" furnace filter as a pre-filter, 24 muffin fans to move the air, and a 3 micron filter bag to catch the powder. Since there are no VOC's (volatile organic

compounds) with powder coat, the risk of fire is very low. Modern powders are rather coarse, so the chance of a dust explosion is almost nil. In commercial powder coating, many of the ovens used are open flame gas units.

Conclusion

Setting up a powder coating facility in your shop can be both fun and rewarding. Except for the gun, most of your equipment can be shop built or converted from other uses. The main expense will be your oven. But the oven has other purposes, like preheating castings for welding, so the purchase will be worthwhile. A great source of information is eBay. By searching for Powder Coating items, you will quickly get a good idea about what is out there, and how much it will cost. Search the internet for articles on powder coating and publications that you can download.