Cure oven maintenance: How to prevent your powder-coated parts from being half-baked

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Cure ovens are an integral part of any powder coating system. Problems with them can mean the difference between having fully cured parts or having field failures, such as coating adhesion difficulties. With little effort, a cure oven can consistently provide the energy required to cure the applied powder coat.

Convection ovens, on the other hand, are the most complex type of cure system, requiring the most upkeep. Burners, blowers, duct work, and associated moving parts need periodic preventive maintenance. Infrared systems, on the other hand, are relatively simple to maintain because they do not have moving parts (except for exhaust fans). As long as the emitters are in good operating condition and properly aimed, they can continue to cure your powder-coated parts. The focus of this article, therefore, will be on maintaining a convection cure oven.

Preventive maintenance
Your first line of defense is to prevent problems from occurring in the first place. Periodic inspection and maintenance can go a long way in eliminating costly downtime or rejected parts. The most important things to check are the oven’s air balance, cleanliness, bearing lubrication, components, and safety devices. Following are weekly, monthly, and annual maintenance schedules that have proved to be effective in keeping cure ovens tuned up.

Weekly maintenance and inspection schedule. Flame failure detector. This important safety device must work properly to prevent raw fuel from entering the oven. An explosion could be imminent if this device is not functioning correctly. Review your oven manufacturer’s recommendations for procedures to check this important device.

Ignitor and burner. Check your oven’s ignition system to see if the spark is strong enough to ignite the fuel mixture. Transformers, spark plugs, ignition wires, and controls should be visually and electrically inspected. The burner should produce a bluish flame in natural gas systems. If it doesn’t, adjust the fuel-air mixture to eliminate costly fuel consumption and soot deposition in the oven.

Burner air filter. To assure that the burner air supply is sufficient for clean combustion, check the air filter (if installed). This device also filters contaminants from the air before they enter the oven, minimizing oven dirt.

Burner blower impeller and motor. The cleanliness of the fan impeller directly affects burner blower efficiency. Periodic cleaning keeps the blower in good condition, preventing premature bearing failure. Keep blower motors clean to avoid overheating, which can cause electrical failure. By simply removing dirt buildup on the motor housing and cooling fins, you can eliminate costly motor replacement.

Heater shell interior. Now is a good time to check the heater shell, or firebox, for cleanliness. Remove soot and other contaminants from this enclosure before they end up on your powder-coated parts.
Fan lubrication. Weekly lubrication of the recirculation fan, exhaust fan, and air-seal fans, assures long bearing life and minimum oven downtime. Because of their location, the lubrication points may be accessible only on weekends when the oven is off. Since you're in that area, check and adjust the fan belts.

Explosion-relief latches. Oven doors not only provide access to the oven interior but also relieve pressure caused by an oven explosion. Make sure the explosion-relief latches are lubricated and able to move freely without interference. Don't store objects in front of and alongside these doors.

Fallen parts and hangers. With the oven off, now is a good time to remove fallen parts and hangers from the oven interior. Left there, they create impediments, guaranteeing conveyor hang-ups during production. Small parts can also block duct-work outlets and cause unbalanced oven airflow.

Monthly maintenance and inspection schedule. Fuel safety shutoff valves. These valves stop the fuel supply in an emergency. Check all manual and motorized fuel valves to see if they are operating properly.

Fan and airflow interlocks. Now is the time to inspect the air switches that regulate air movement and fan operation. These devices assure that the oven is purged properly before ignition. They also assure that the fans are providing the correct air movement in and out of the oven. It's a good idea to check the time delay circuit for oven purging now.

Conveyor interlocks. If your oven has an interlock system to the conveyor, check to see if it is working properly. An interlock system automatically turns down the oven temperature if the conveyor stops. Following your manufacturer's instructions, do a simple electrical check within the control panel.

Limit switches and high-low fuel pressure interlocks. Limit switches that eliminate problems, such as fan wheel failures, when temperatures of more than 450°F are reached should be checked next. Also check the high-low fuel pressure interlocks in the gas valve train. Always follow the manufacturer's recommendations when adjusting these devices.

Gas drip leg. The gas valve train has a drip leg with a petcock, or small valve, that drains sediment from the gas supply line. Drain the drip leg monthly so sediment doesn't clog burner components downstream.

Oven cleanliness. Oven dirt is a typical problem in many powder coating systems. Monthly cleanup will assure the highest coating quality on your production parts. Be sure to vacuum the oven walls and floor, duct-work interior, and conveyor components (support steel, wheel turns, rails, and so on). Using a damp mop on these surfaces also helps remove contaminants.

Annual maintenance and inspection schedule. Many plants shut down annually to do system checks that are too time-consuming to do during the production year. Review your manufacturer's recommendations for annual inspection, adjustment, and replacement of components in the following oven areas:

- Ignition
- Burner
- Combustion air supply
- Flame failure system
- Combustion controls
- Pipes and wires
- Thermocouples
- Automatic fire suppression
- Operating sequences

If a component is suspect, replace it right away instead of waiting until it fails during production. Annual maintenance should not be taken lightly or ignored if you want to be trouble-free throughout the production year.

Oven profiling

Oven profiles should be performed periodically. Many end users include this test in their statistical process control procedure. Often called "the roadmap to curing success," the oven profile curve shows you important information about your oven's performance.

Oven profiles are done with a chart recorder. This device measures oven temperature in relation to time and displays a graph on a chart. You can borrow a chart recorder from your powder coatings supplier. For accurate oven profiles, use a multichannel type with at least three thermocouples.

Hang the device from a part hanger, and attach two of the thermocouples to the part. Attach them to the part's highest and lowest points. You can also attach them to the part's thinnest and thickest areas to determine if a full cure is taking place in the oven. The third thermocouple measures oven air temperature only and should not be attached to the part.

After the oven is up to operating temperature, start the conveyor and run it at your most common line speed. Load the part hanger with the chart recorder onto the powder coating line in the middle of a full load of parts. This will assure that the results reflect actual operating conditions. After the chart recorder completes its run through the oven, remove the chart from the device to examine it. To produce a chart in some units, a memory module must be connected to a computer, a printing device, or both.

The oven profile graph shows part temperature rapidly rising to the minimum temperature required for the powder coating to cure (available
Dips in the curve that show the part dropping below cure temperature denote cold spots in the oven. Examine these oven areas to see if the air is circulating properly. You may need to adjust the duct work or dampers to increase the air circulation in these areas to smooth out the oven profile curve. Refer to your oven manufacturer's manual for the best way to correct this problem in your oven.

Conclusion
An improperly maintained cure oven can cause many problems in coating quality. Air control problems in your oven can cause the powder to blow off the part before it melts and wets the surface. Dirt, soot, and other contaminants can damage a coating's appearance. A powder's color stability can also be affected if your oven's exhaust rate is adjusted improperly or the powder is overbaked. What all these add up to is an increase in downtime and your reject rate. So, before you go off half-baked, make sure you plan a good preventive maintenance program—and stick to it.

Note
For further reading, the author suggests the Powder Coating Institute's *Powder Coating System Troubleshooting Guide*, available through PCI at 703/684-1770.

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