

\$5.00

ECD, INC

INDUSTRIAL QUALITY CONTROL APPLICATIONS SERIES

Guide To Product Cure Optimization



Powder Coating



ECD Is Dedicated To Providing Powder Coaters With Today's Best Systems For Optimizing Powder Cure Quality

ECD, founded in 1964, is the world's largest manufacturer of thermal profilers for the electronics industry. Many of these profilers found their way into the painting industry. In order to bring our full thermal profiler expertise to the paint market, ECD has been working with Powder Coaters on a worldwide basis to develop our new CureTRAK™ Product Quality Optimization System.

This Guide represents the input ECD has received from Powder Coaters like yourself who have been searching for a simplified, low cost tool to optimize, control and document the quality of their cure finish. Many of you expressed concern about product liability issues and asked for a way to prove and document cure quality for both your customers and your internal QA/QC departments. Others of you required a rapid and accurate method for producing ISO 9000 quality documentation. We also heard that many powder coaters were anxious to reduce scrap rates and energy consumption in an effort to maximize profit levels.

In addition to the above requests, every powder coater we spoke to was unanimous in their request for both a low cost and easy to use solution to their product cure quality concerns. As a result of listening to your needs, ECD is pleased to introduce the new CureTRAK Product Cure Optimization System. You now have an integrated cure quality measuring system that allows you to both optimize and document the quality of each and every run of products you produce. Our in-house staff of hardware and software engineers have also worked hard to develop a quality measuring system which will meet your budgetary requirements.

We hope that you find this Guide a valuable addition to your technical library. Please continue to provide us with your comments by utilizing the quick response card included with the Guide. Thank you again for your continued interest in our line of products developed for the powder coating industry.

Best Regards,
ECD, Inc.



Rex Breunsbach
President and Chief Operating Officer

The ECD Guide To Product Cure Optimization

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Your Guide To Optimizing Cure Quality

As the Powder Coating Industry Expands Into New Applications, Customers Are Demanding Higher Quality Standards, Controls & Documentation

Introduction

The excitement builds as the start up procedure of a new powder finishing system begins. Months of planning and hundreds of thousands of dollars went into the project. Finally the washer is heated, the oven is started, and the conveyor begins to move. Minutes seem like hours in anticipation of the first coated test panels to emerge from the system. As the sample panels exit the oven they are allowed to cool before quality testing begins. So far everything looks great, the finish is glossy and smooth. Upon closer examination however, the panels have failed the simple impact test (ASTM D-2794). Additional testing was performed by crosshatch adhesion (ASTM D3359) and confirms the coating did not complete the full cure cycle.

Potential Cure Cycle Problem Areas

The above problem typically occurs when a number of key process parameters are outside of normal control values. Possible trouble spots include:

1. Too low an oven atmospheric temperature
2. Uneven heat distribution within the oven
3. Poor airflow or venting of the air inside the oven
4. The work-piece was not in the oven long enough to reach the proper cure temperature or spent an insufficient time at the cure temperature

The cause of the problem is clearly under cure of the powder coated finish. The finish did not receive enough heat energy for the correct amount of time to properly cross-link and cure. But how do you know what to do to correct the problem? The answer is product temperature profiling.

System Profiling vs. Product Profiling

As soon as the construction of a powder coating convection oven is completed, adjustments are made to maximize the efficiency of the equipment as a unit. This is done by adjusting the operating parameters of the oven based upon a system temperature profile obtained from a system profiling instrument. Adjustments can now be made to the fuel and air ratios, air flow, air recirculation and air balance. All of these factors are critical to the oven's performance. This is accomplished by increasing or decreasing air and fuel mixtures, opening and closing the air ducts, increasing the air volume and changing the direction of the air flow.

Unfortunately, for many companies, this installation system profiling is the only time the oven is profiled and adjusted before a potentially catastrophic problem occurs. Until recently, the high cost and complexity of system profiling instruments made it difficult for all but the largest powder coating operations to own their own profilers.

With the introduction of the new, low cost, ECD CureTRAK™ Product Quality Optimization System, professional powder coaters are now product profiling each of their production runs. By profiling each lot of product, powder coaters are able to:

1. Minimize Product Liability Risks
2. Significantly Reduce Operating Costs and Maximize Profits
3. Improve Processing Capacity
4. Improves Sales and Satisfy Customer Demand For Cure Conformance Documentation

The Benefits Of Product Profiling

The low cost and ease of operation of the ECD CureTRAK™ Product Quality Optimization System provides powder coaters with a reliable product profiling tool for everyday use. Let's briefly review each of the benefits listed above:

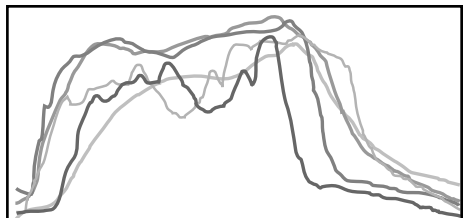
1. Product Profiling Minimizes Product Liability Risks

Risk management is a real concern for every business, and powder coating is no exception. The product liability of providing a poor quality powder coating finish could range from re-coating a few simple parts to the replacement of all products damaged by underexposure or overexposure to heat (a complete product recall). The only way to totally manage risk is to be in total control. In turn, verification of control can only be certain when measurements are taken by proper testing equipment. Quality is a matter of fact and does not happen by chance. Today, it doesn't make sense to knowingly operate out-of-control when tools are available to guarantee control.

Products such as high-pressure gas cylinders are powder coated everyday. These cylinders are made from a special aluminum alloy and cannot exceed specific temperatures that are very close to the cross-link temperatures of many coating materials. If this temperature is exceeded, pressure failure may occur due to the molecular change in the aluminum alloy. In fact, it is necessary for product liability purposes to confirm that the aluminum cylinders have not at any time exceeded the specified upper temperature limit. It is for this reason that profiling is very critical. Many companies require a Certificate of Conformance to insure the upper temperature limit was never exceeded.

2. Product Profiling Significantly Reduces Operating Costs & Maximizes Profits

Scrap and rework are not the only costs of not knowing how your curing is progressing. Excessive energy costs are an often overlooked. That is why professional powder coating companies proactively manage their cure windows.



The Cure Window

To fully appreciate the heat energy required to cure various coating materials on a variety of substrates, the metal finisher must understand the relationship between temperature, time and mass. The powder material cure requirements are outlined by the product's technical data sheet. This information typically is given as time at temperature. For example: 10 minutes at 350 degrees F. However this does not mean the coating will always cure on all substrates exposed for 10 minutes total time in the cure oven at an atmospheric temperature setting of 350 degrees F. Thin metal parts will ramp to temperature much quicker than larger heavy weight parts.

Processing parts of heavy and light mass at the same time can further complicate variations in time, temperature and mass. Parts consisting of both heavy metal and light thin metal construction require special attention when attempting to establish the correct time and temperature. If the coated workpiece is exposed to more heat than necessary for too long of a period of time, it may cause over-bake and a loss of some or all of the coatings properties. It will always cause a higher energy bill than was necessary. On the other hand, if the substrate and the powder have not reached sufficient temperature for the proper amount of time, as specified by the powder manufacturer, the powder coating material will not cross-link at all. In either case, failure of the finish will occur (which may or may not be immediately evident).



Product profiling in process using ECD CureTRAK™.

To proactively manage your cure window, two different types of checks are performed. First, thermal profiling **checks are made on the oven** periodically (weekly or, at minimum, monthly) to evaluate the evenness of the heat energy distribution within the oven. Second, and most importantly, thermal profiling **checks are made on the parts** as they are being cured. A time-temperature-substrate mass relationship is determined by establishing a quantitative graph of time and temperature as the oven's atmospheric environment transfers the heat energy to the substrate's mass.

Scrap, rework and energy costs may be kept to a minimum by the routine collection of accurate thermal exposure data in an easy to understand report, typically in a form of an X-Y (time-temperature) chart. This data is commonly used as proof of conformance to end use customers that the finish was cured to the powder manufacturer's time at temperature specification. Professional powder coaters never leave quality or energy costs to chance.

Consider the following simple relationship between costs and profits:

Cost + Profit = Price to the customer.

If costs go up, profits go down. Profits are simply money received in excess of costs. **Rejects eliminate more than Profits from the equation.**

Here's how rejects and rework can negatively affect your profits:

Rework Example 1.

Re-coating:

Finishing Cost + Refinishing Cost = Loss \$

Rework Example 2.

Stripping & Re-coating:

Finishing Cost + Stripping Cost + Refinishing Cost = Loss \$\$

Rework Example 3.

Scrapping out the customers part:

Finishing Cost + Part value + Refinishing Cost = Loss \$\$\$

The cost associated with each of the above mentioned examples can be tracked over time. The exact cost of rejects over time is never a simple formula. Many factors must be considered to realize the exact cost of failure, and in each case it will be different. In some cases the result of failure is not always possible to calculate with a simple mathematical equation. Loss of goodwill, as well as potential loss of repeat business is a serious concern. Justification for the purchase of the proper equipment to insure total cure of the finish is an easy task when comparing the cost of such equipment to the high cost of failure.

It is easy to see how the professional powder finishers' ability to proactively control their cure windows gives them a significant cost savings edge over other companies.

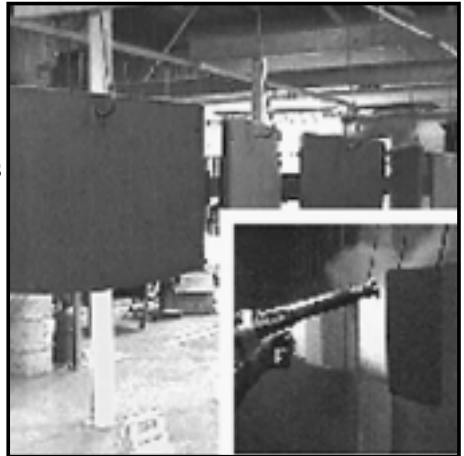
3. Product Profiling Improves Processing Capacity

Confidence and control offered by knowing what is happening inside the cure oven will allow processing personnel to eliminate "trial and error" sample runs. The more time saved on a production run means that much more time is available for other production runs. This in turn translates into a longer time before a new oven or addition will be necessary for meeting more demanding production schedules as a result of increased business.

4. Production Profiling Improves Sales

Total Quality Management (TQM) and quality driven management systems such as ISO 9000, QS-9000 as well as CE marking have redefined the meaning of quality partnerships. Professional powder coaters have begun profiling all of their production runs, not only to reduce their product liability risks and reduce their operating costs, but also to send quality documents along with ALL of their shipments. This proves quality to their existing customers and helps to ensure their long-term loyalty. Manufacturing companies are sure to partner with finishing companies that have solid control systems. Quality control tools are an essential investment in retaining customers, not simply an expense. Those who say what they do, do what they say, and are able to prove it, will prevail over those who pretend to be in control.

These companies' sales people are using this 100% quality documentation as a way to beat their competitors. They are capitalizing on every opportunity to take their competitors' customers and impress them with their quality system and documentation. Additionally, new developments in low temperature powder curing have opened doors of opportunity for powder coating. Current applications of glass, wood and manufactured fiberboard are growing in popularity.



When applying powder coating to *Powder coating nonmetallic substrates* MDF wood, high temperature plastics and composite materials tempera-

ture control is critical. The substrate material's composition may break-down at a temperature very close to the coating's cure temperature. This thermal breakdown limitation on various nonmetallic substrates has limited the use of powder coating materials for many years. Powder formulations are being developed for cure at lower temperatures and the use, control and selection of low temperature powders is growing each year. These new application customers will be won by those powder coaters that have the equipment and knowledge that is necessary to guarantee the successful processing of the customer's parts in these new tighter operating and cure windows.

Now that we have discussed the main reasons why professional powder coaters are profiling their production runs, let's examine some common questions about profiling.

Today's Most Commonly Asked Questions Concerning Product Thermal Profiling

Do I really need to profile my products? My oven supplier certified my oven when I first purchased it.

Don't forget the variable relationships that exist between the time, temperature and product mass. One system profile is not enough to assure the quality of each run of products you powder coat! Not only do things change (baffles get knocked, fans wear, formulations change from batch to batch, humidity and external temperatures change with the season, etc.), but also each part number that you run has a different mass. Only by tracking and controlling the actual product cure window can you reap all the benefits of running a quality manufacturing operation.

Why do I need to profile? My powder supplier does a free profile whenever I want one.

This is probably today's most frequently asked question. Relying on someone else to profile your products simply is not a good idea. If you have a cure problem, are you going to shut all your production down for

days at a time? Do you continue to run in the mean time, possibly generating lots of scrap and rework? How are you going to fine tune your operations to reap the cost savings advantages mentioned earlier? Are your competitors going to steal your business with a better quality system? Having your own product profiling system lets you identify and correct problems, instantly minimizing downtime and scrap, and improving overall quality.

Isn't Profiling equipment too complicated for my operators to run?

Thermal profiling equipment has become quite simple to use and easy to understand. Often the equipment comes with a quick reference operator's guide and their reports are self generated which confirm operating conditions, finish and substrate exposures. It has become an easy four step process.

- Step 1. The data collection box is activated and placed into the insulating box.
- Step 2. The insulating box is hung on the line with your parts.
- Step 3. The thermocouple wires are attached to the parts and you start production.
- Step 4. Upon exit, you remove the insulating box and take the data collection box to your computer where your data is analyzed and reports are printed.

You do not have to be a powder chemist or an engineer to collect and look at your production information anymore.

I've heard that profiling equipment is expensive. Can we afford to purchase a product profiling system?

Originally, profiling equipment ranged from \$6,000 to \$8,000. Today's costs range from about \$2,000 to as high as \$10,000 for specialty applications. Excellent product profiling systems with six channel measurement capability run about \$2,000 to \$3,000 per unit for both conveyORIZED line and batch models. Regular oven and part profiling will reduce the risk associated with under-cured and over-cured parts, thus preventing costly mistakes and saving you thousands in reduced operating costs. Most systems pay for themselves in three months or less!

What Exactly Is the CureTRAK™ Product Quality Optimization System?

The CureTRAK™ Product Quality Optimization System is specifically designed for the product profiling needs of powder coaters. ECD consulted extensively with many powder coater operators concerning both the design and development of this break through system. CureTRAK™ has also been successfully tested in a variety of live powder coating settings to be certain that the product can withstand actual oven conditions and still provide optimal performance.

During CureTRAK™'s design and development process, powder coaters constantly told us that existing oven profiling instruments were too expensive and somewhat complicated to operate. ECD was challenged to develop a low cost, easy-to-operate product profiler that could be used on a daily basis to confirm the cure quality

As a result of listening to the powder coating industry, ECD has introduced the CureTRAK™ Product Quality Optimization System. CureTRAK™ will help you improve control over product quality while allowing you to fine-tune your process to maximize operational profits.

How Exactly Does the CureTRAK™ Product Quality Optimization System Work?

Here's how the CureTRAK™ Product Quality Optimization System works:

- The CureTRAK™ Product Quality Optimization System goes into the oven to track the exact temperature of your product ... requires no setup or programming!
- Attach thermocouples directly to your work piece ... choose thick, thin, high or low areas, plus monitor the air temperature of your oven using up to six channels.
- After emerging from the oven, simply plug the CureTRAK™ data module into any available computer to view your product thermal profile and print your certificate of cure conformance.

How Will the CureTRAK™ Cure Optimization System Benefit My Powder Coating Operation?

The CureTRAK™ Product Cure Optimization System provides many benefits for your powder coating operation:

- **CureTRAK™ provides proof of your product's quality.** With a touch of a button, CureTRAK™ prints a certificate that verifies the quality of your product cure cycle. Now you and your customers will have the peace of mind knowing that each and every product produced by your facility will provide years of lasting durability and good looks.
- **CureTRAK™ prints a Certificate of Cure Conformance on each order you run ...** perfect for satisfying ISO 9000 quality documentation requirements for both your customers and your internal QA/QC departments. Also helps reduce product liability risks.
- **CureTRAK™ maximizes your profits** by allowing you to pinpoint the exact cure time. Under-cure problems can be eliminated and scrap rates reduced. At the same time CureTRAK™ allows you to increase your line speed, increasing capacity and throughput, while reducing overall energy consumption.

Is the CureTRAK™ Product Quality Optimization System Easy to Operate? Will All of My Line Operators Be Able to Use the System on a Daily Basis?

CureTRAK™ is extremely easy to operate.

- No setup or pre-programming is required. Simply turn the data module on and place in the protective thermal barrier. Connect thermocouples to your product and run through your oven. When finished, remove the data module, connect to any computer and CureTRAK™'s special software program automatically extracts the cure run data. At the touch of a button, print your certificate of cure conformance and/or ISO 9000 quality verification document.
- The CureTRAK™ System also includes a one page, plastic laminated quick reference operations manual. The quick reference guide provides simplified, illustrated, step-by-step procedures and has been thoroughly tested by a variety of line operators. A complete reference manual is also included.

- CureTRAK™'s unique software system is multilingual. Change from English to Spanish to German to French or to Italian ... on the fly!
- Actual use has shown that operators of all skill levels and during all shift work times can easily utilize CureTRAK™. Plus, the illustrated quick reference guide and multilingual software means that non-English speaking employees will have no trouble operating the CureTRAK™ Product Quality Optimization System.

In the Past, System Profilers Have Been Expensive and Unaffordable For Individual Powder Coaters. How Expensive is Your CureTRAK™ System?

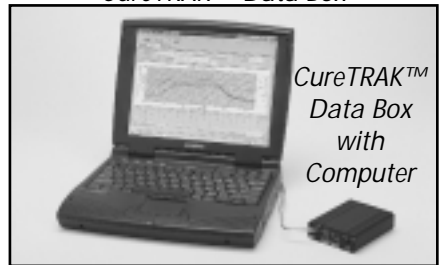
Based on our consultation with powder coaters, the CureTRAK™ Product Quality Optimization System is priced at about 1/4 to 1/3 the cost of other profilers on the market. Six channel systems are priced at less than \$2,600. Most powder coaters are able to pay for the system in less than 3 months due to the cost savings they realize from reduced scrap rates, lower energy consumption and improved capacity.

SUMMARY

It is easy to see why professional powder coaters profile regularly. The reduction in product liability risks, the operating cost savings, the production capacity throughput increases and the sales improvement opportunities are compelling reasons to profile your production runs on a daily basis. Control is essential to any successful production operation. Without complete data and accurate information, quality is just a guess. Products such as the ECD **CureTRAK™ Product Quality Optimization System** provide today's powder coaters with a low cost, easy to operate tool to assure optimum product quality on each and every production run.

Product profiling will improve and document the high quality of the products you produce while reducing scrap and energy consumption. The bottom line: more profits for you and better quality for you customers. You will feel more confident and satisfied with your overall operation and your customers will be delighted - a true win/win scenario.

CureTRAK™ Product Cure Optimization System Product Information

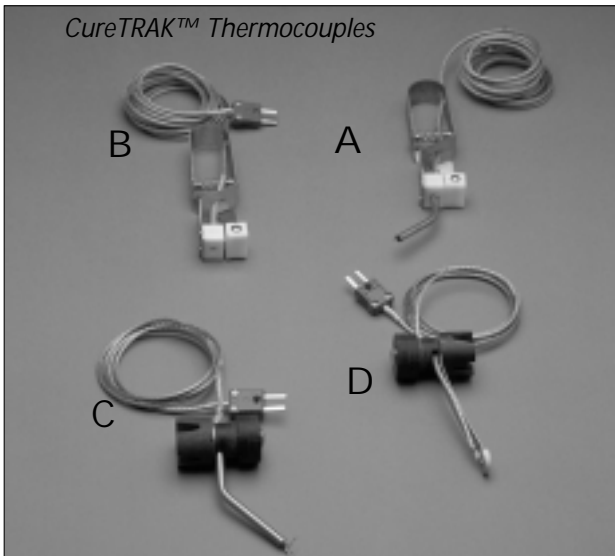


CureTRAK™ six channel system kit includes everything you need to properly monitor the curing cycle of your powder coating operation...there is nothing else to purchase. Consider what a CureTRAK System offers you:

- Full six channel data collection system
- Fixed six second log interval with two hour log time capability
- Performance: 45 minutes at 500°F/260°C; 65 minutes at 400°F/204°C; 90 minutes at 300°F/150°C
- Set of six, heavy-duty stainless steel overbraid thermocouples with clamp-on and magnetic attachment for measuring both air and surface temperatures (Accuracy $\pm 1^{\circ}\text{C}$)
- Rugged stainless steel protective barrier
- ECD's advanced cure predictive software system...allows you to predict proper oven settings for 100% Cure Factor
- One-Click, easy-to-manage cure report generation system
- Laminated one-page quick reference guide along with complete product manuals
- Multi-language software includes English, Spanish, French, German and Italian
- Now specially equipped for low temperature curing applications

Your CureTRAK System Kit includes (ECD Product # E38-2873-26)

- Six-channel data logger
- Six-channel stainless steel protective barrier
- Battery Charger
- RS-232 download cable
- CureTRAK 1-click data reporting software
- Advanced SourceTRAK cure-prediction software system
- One-page laminated quick reference guide
- Hardware & Software operations Manuals
- One air temperature clamp-on sensor
- One air temperature magnetic sensor
- Two surface temperature clamp-on sensors
- Two surface temperature magnetic sensors



Advanced ECD INDATA® Powder Coating System Profiling Kits

Featuring Optional Real Time RF Transmission of Temperature Data and Advanced Software Analysis Programs

ECD INDATA® powder coating profile systems feature advanced SourceTRAK™ analysis software and optional RF real time transmission of thermal data live to your computer. This configuration provides you and your customers the ability to watch the actual cure process temperature at up to six locations on the work piece as it passes through your oven.

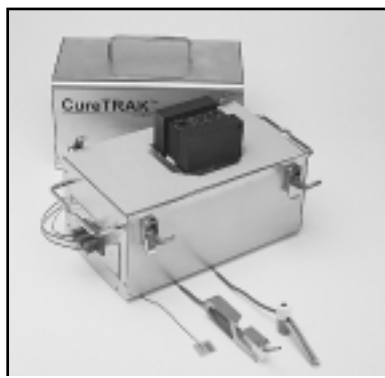
Besides real-time capability and a choice of thermal barriers and thermocouples to match the job, INDATA® kits not only measure temperature but can also provide the ability to measure UV curing processes and Air Velocity, useful for balancing spray booth pressure and oven baffle adjustments.



INDATA® kits with SourceTRAK™ software offer powder coaters these analysis tools, options and benefits:

- Measure a combination of up to six substrate and oven temperatures in conveyor and batch ovens with a traveling data recorder
- Full programmability of log interval, temperature trigger start and profile time shutoff
- Perform a variety of Quality Assurance Process Monitoring with a wide range of barriers and sensors

- View the Cure Window as it's established within your oven while it's happening with the real-time, FCC-approved RF wireless option
- Program up to three audio/visual Real Time Alarms to alert the operator the temperature not to exceed [aluminum, MDF, plastics] and cure schedule thresholds attainment
- Quickly design a new curing line by observing the point of full cure with the new product on a stopped line or batch oven in real-time [w/RF option]
- Model the oven in SourceTRAK software, describing zone temperatures, lengths and line speed
- Profile Ultra Violet energy while measuring temperature at the same time with the UV sensor(s). And do this in real-time by combining the RF option
- Measure UV intensity in Watts per sq. cm or sq. in. and UV Dosage in Joules with SourceTRAK's 'Total Heat' integration tool and UV sensor
- Profile three channels of air velocity in units of Ft./Min. or M/Min. and do this in real-time when combined with the RF option. Saves considerable time with baffling adjustments
- Program up to three powder Cure Schedules, and SourceTRAK calculates a combined aggregate Cure Factor percentage value
- Perform Dynamic Prediction upon the baseline data to adjust the process to 100% cure top-to-bottom, and thick to thin areas of the work piece
- Store all of your runs, sortable by part number or customer, etc. for future retrieval
- Gain new customers and satisfy ISO documentation requirements with professional color hardcopy Cure Data reports for every processed lot



*CureTRAK™ , cover removed
exposing data box and heat sinks.*

Please contact ECD for additional ordering information

Part Number

INDATA Gold Curing Profiling System.....SE37-4286-50/SE29-2686-90

Included items:

- INDATA Gold 6-channel Data Profiler
- 2 Rechargeable Power Packs & Power Pack Charger
- Multilingual Advanced SourceTRAK™ Analysis Software Package (includes English, Spanish, German, French, Italian)
- Operation Manual
- INDATA Super Hot Box Thermal Barrier
- RS-232 Cable & Connectors
- Deluxe Carrying Case
- Certificate of Traceability to N.I.S.T.

INDATA Gold Radio

Part Number

Frequency Curing Profiling System.....SE37-4286-57/SE31-0908-80

Included items:

- INDATA Gold 6-channel Data Profiler
- 2 Rechargeable Power Packs & Power Pack Charger
- Multilingual Advanced SourceTRAK™ Analysis Software Package (includes English, Spanish, German, French, Italian)
- Operation Manual
- INDATA 60 Thermal Barrier
- RF (900 MHz) Transmitter/Receiver/Antenna Kit
- RS-232 Cable & Connectors
- Deluxe Carrying Case
- Certificate of Traceability to N.I.S.T.

ECD has a comprehensive selection of thermal barriers and accessories to serve the cure profiling needs of the powder coating industry.

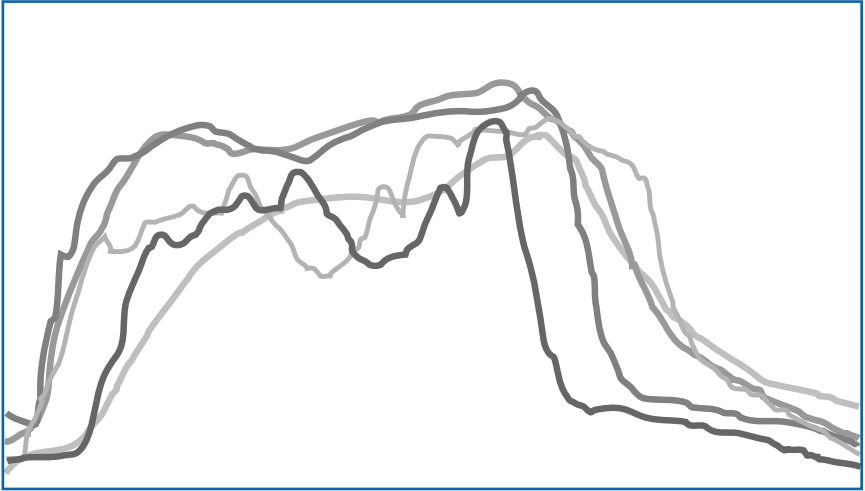
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CureTRAKTM

Product Quality Optimization System



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