

PAINTING PROCESS DEVELOPMENT

DEPARTMENT OF COATING SYSTEMS AND PAINTING TECHNOLOGY



EVALUATING AND APPROVING PAINTING PROCESSES –

WE CAN HELP!



The first impression is crucial. Whether matt or glossy, the finish must be flawless. Behind this desired result is a highly complex process, which must be understood in all its steps and optimally designed in order to meet the high quality requirements of appearance and feel as well as chemical and mechanical properties. Since each painting process has its own specific characteristics, suitable testing methods must be selected to ensure a robust process.

Under one roof – planning competence, accredited testing and analysis facilities, production-related painting technology

In the Coating Systems and Painting Technology Department, our painting process development team – composed of qualified engineering and scientific experts – is familiar with interdisciplinary tasks. Our central testing laboratories are fitted with all the relevant equipment. You can find a detailed overview of all available test procedures and devices in our test equipment catalog "Equipment for testing technology and analysis in the Coating Systems and Painting Technology Department".

We work on inspection tasks for painted components made from plastic, metal and wood in accordance with the respective specifications. On this basis, we develop new test methods for special requirements and conduct research on behalf of customers as well as in the context of publicly-funded projects.

Planning high-investment paint shops calls for engineers with sound industrial experience as well as knowledge and understanding of methodical and systematic procedures. Over the past four decades, Fraunhofer IPA has attained an important position in this field, as demonstrated by a large number of national and international projects in many industries. The spectrum of activities ranges from one-day consulting to comprehensive paint shop design and commissioning, and also includes optimizing quality, costs, energy and processes. At the same time, we take into account process and product

quality, cost-effectiveness, as well as environmental protection and work safety aspects.

Our services

Our industry-based research and development work focuses on the following areas:

Planning

- Painting process and paint shop planning
- Concepts for production-integrated painting
- Compiling specifications
- Support with applications
- Technology assessments

Optimization

- Analysis of weak points and painting defects
- Cost and quality optimization
- Improved productivity

Testing technology

- Conducting technical tests and sampling projects
- Developing testing methods
- Technology assessments

Expert reports, workshops, seminars and in-house training courses



OUR APPROACH TO SAMPLING PROJECTS

Our practice

Many exterior and interior components, as well as entire component groups for automobile manufacturers, are manufactured and painted by external suppliers. In order to check and ensure the suitability and quality of these purchased parts, sampling trials are conducted that culminate in the approval of the series production process.

These approval tests vary widely within the industry. Defined in the respective automobile manufacturer's delivery specifications, they are generally based on existing DIN standards.

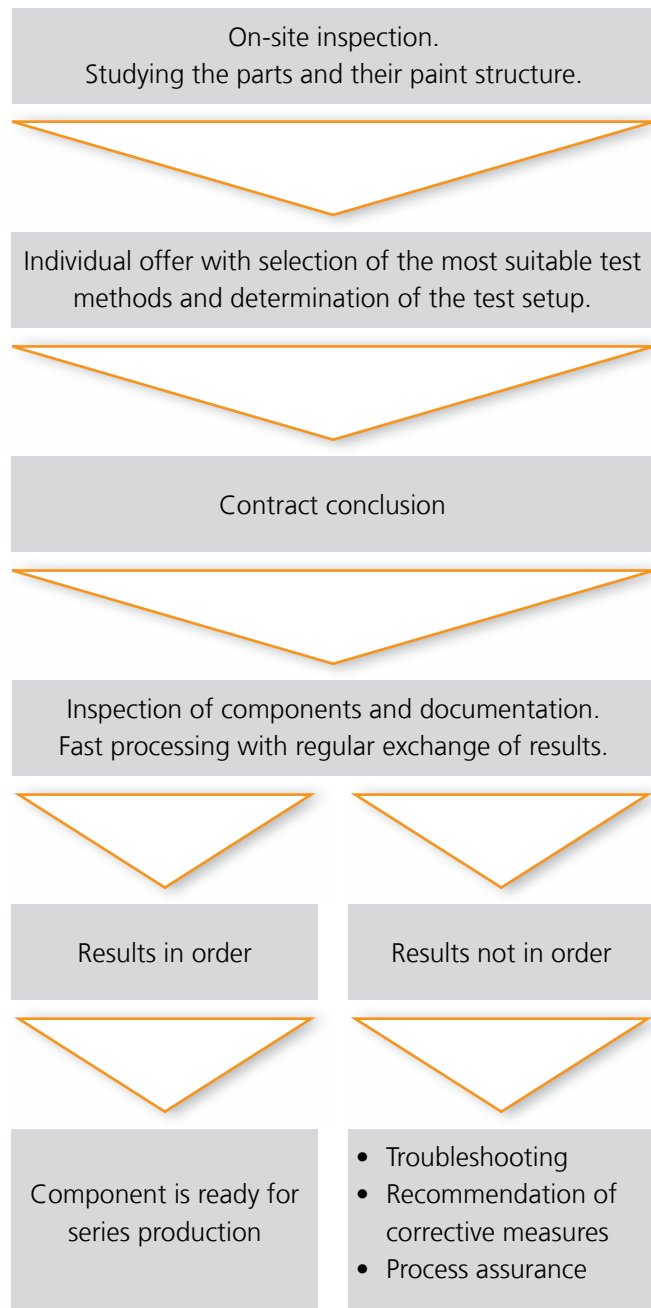
Thanks to years of close cooperation with OEM's, our central testing laboratory is familiar with the existing delivery specifications and necessary test programs and is recognized as a competent partner.

Accredited testing laboratory

As a testing laboratory accredited according to DIN EN ISO / IEC 17025, we help you evaluate and approve the painting process. We inspect and sample the painted components according to their specific requirements, ensure their practical suitability and make your product ready for the market.

Within the scope of sampling tests, we assist our customers with the following:

- Developing specifications
- Preparing work instructions
- Staff training
- Developing test instruments



TEST METHODS IN OUR LABORATORIES



In our central testing laboratories, we work on projects from a number of industries, such as the automotive industry, the supply industry, mechanical engineering, furniture and timber construction and many more. The choice and application of appropriate testing methods are essential to quality assurance and cost containment. Some of the painting technology test methods we currently use are shown below.

Our testing methods and techniques (examples)



Mechanical test methods

- Adhesion tests (e.g. cross-cut, steam jet, multi-impact, etc.)
- Hardness (pendulum damping hardness, indentation hardness etc.)
- Scratch/abrasion test (laboratory washing system, Taber Abraser etc.)



Climatic test methods

- Condensation test
- Temperature change test
- Salt spray test
- Xenon test



Chemical test methods

- Resistance to cleaning agents
- Resistance to different chemicals
- Swelling capacity



Visual test methods

- Color
- Brilliance
- Haze
- Appearance: instrument-based measurement of surface structures with DOI wave scan



Environment

- Fogging
- Combustion test
- Particle and VOC tests
- Airflow
- Heat distribution



DEVELOPING TEST EQUIPMENT: PRACTICAL EXAMPLE

A well-known test method for determining abrasion resistance is the Taber Abraser method; however, this is unable to provide sufficiently comparable or reproducible results in many applications. The reason for this is the loose debris that is produced during the testing process and adheres to the abrasive wheel. This debris influences the subsequent abrading processes in an uncontrolled manner.

Development of a new test method for determining the abrasion resistance of coatings

The new test method

The principle of the abrading process is based on linear back and forth movements of an abrasive wheel, which is mechanically blocked in one direction and thus causes the abrading effect.

A special freewheel clutch with a ratchet is used to block the wheel. The wheel diameter and path of travel are precisely matched to ensure that the abrading process always takes place on an uncontaminated part of the abrasive wheel.

This minimizes the influence of the generated abrasion dust on the subsequent abrading process. To ensure reproducible results, the abrasive wheel must always rest flat on the coating. This is made possible by a pivot-mounted axis. Depending on the paint system investigated, different kinds of abrasives can be clamped round the abrading wheel.

With the ideas developed so far, a first prototype, the "Mini-Martindale", has been designed with the support of the James Heal company (see illustration).

Analysis

The tests are evaluated either gravimetrically using precision scales, or by profile analysis using the stylus method. With profile analysis, a diamond-tipped pin is drawn across the abrasion path. This results in a height profile. The difference in height determined from this profile is in turn used as a measure for the abrasion resistance or scratch resistance of the tested paint system.

Advantages of the new method

With the new device we have been able to achieve both functional and economic improvements:

- Good results obtained when testing hard coatings for abrasion resistance
- Good differentiation between coatings
- High accuracy and reproducibility
- Easy to use
- Low purchase costs
- Minimal testing effort
- Fast execution
- Can be used to test a wide range of coatings
- Portable

PLANNING AND OPTIMIZING PAINT SHOPS AND PROCESSES



The planners in the Painting Process Development Group apply recognized simulation and evaluation methods. They check the processes, paint shop components and paint results at the IPA Surface Technology Center, which is designed with production in mind. Together with the supplier companies, the knowledge gained in each planning phase is documented and summarized for you as a basis for decision-making. The aim is to optimize the processes (or products) in companies with the help of energy-efficient paint shops that minimize emissions and waste. Throughout the entire improvement process, the focus is always on the needs of the customer.

Our approach

Among others, we assess the status quo with regard to:

- Paint shop description
- Material flow
- Paint-related data
- Key data of the coating properties
- Key data of the paint application process
- Coating process costs
- Current requirements

Our on-site weak-point analysis to determine the potential savings is conducted empirically and through targeted measurements and tests.

Examples include:

- Spraying parameters
- Paint material utilization rate
- Paint shop utilization
- Air conditions in the spray booths
- Material flow
- Required paint layer structure
- Paint film thickness and distribution
- Energy analysis
- Rework statistics

To evaluate the status quo and assess optimization options, we prepare a detailed requirements catalog and a trend analysis. In the catalog, the decorative and functional requirements are defined for all parts, as well as the constraints of the paint shop and painting process. The trend analysis takes into account anticipated future developments, e.g. with regard to coating quality, parts spectrum, colors and paint structures, and also environmental protection requirements.

Painting costs check-up

Painting lines are high-investment facilities which generally have a long service life. The processes planned and implemented at the start, such as pretreatment, as well as coating materials, equipment or paint structures, may change during the life of the paint shop throughout the life of the plant. In fact, continuous improvements in the painting process are essential to ensure competitiveness. Rationalization must be carried out in a sensible way by systematically analyzing and weighing up the benefits of potential improvements. In doing so, the focus is on both cost reduction and plant efficiency. Paint shop operators are finding it more and more difficult to identify all the detailed issues and solutions adequately and to keep track of the latest developments.

Fraunhofer IPA is a neutral research partner that provides tailor-made solutions.



COATING SYSTEMS AND PAINTING TECHNOLOGY OPTIMIZATION PROJECTS

Outsourcing process analysis

A commonly-used approach to overcome with this challenge is to outsource such tasks to a neutral institution. Outsourcing a process analysis at regular intervals to Fraunhofer IPA offers manufacturing companies a number of advantages:

- The ability to focus on core competencies and day-to-day business
- Rapid availability of qualified staff
- Flexible application of scientific testing and evaluation methods
- Integration of new knowledge and experience
- Staff savings

Practical Example 1

Company: Manufacturer of steel furniture

Assignment: Reduce rework rates in the painting line for decorative parts

Status quo: Current rework rate approx. 20%

Solution:

- Record status quo with regard to failure rates
- Empirical, analytical and chemical studies to find the root cause
- Prepare a catalog of measures
- Optimize the painting process in cooperation with the people concerned and develop a cleanliness concept with staff training

Result: Rework rates reduced by 33%

Conclusion: A systematic quality improvement process increases production reliability and avoids rework costs.

Practical Example 2

Company: Motor manufacturer

Assignment: Improve capacity by ~30 %

Status quo:

- Assembly of partly pre-coated single parts
- Priming coat to standardize the color
- Top coat (gray)
- One spray booth for primer and top coat

Solution:

- List all single parts and their pre-coatings
- Analyze claims regarding corrosion
- Draw up a requirements catalog
- Conduct trials with the new pre-coatings at the suppliers', in particular a light gray spray primer instead of black dip coating

Results:

- A spray primer is no longer required for 50% of all motors. For the remaining motors, the cycle time for priming has been cut by around 30%.
- In 3-shift operation, about 50% more motors can be sprayed per day.
- There is no longer any need to expand the painting lines (high investment costs).
- Major reduction in painting costs.

Conclusion: By designing parts suitable for painting, using appropriate materials, and transferring painting processes to pre-fabrication, substantial savings can be made.

*Painting at Lufthansa Technik AG
Photo: Baerbel Ritlewski*

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