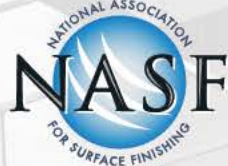


2019 COURSE CATALOG



NASF.org

4 Convenient Learning Platforms

- ▶ web-based
- ▶ classroom
- ▶ home study
- ▶ custom

KNOW MORE

Whether you're new to the finishing field, or consider yourself a veteran, there are learning opportunities described in the next few pages that will increase and deepen your knowledge of this complex and evolving industry.

NASF, and its education arm, The AESF Foundation, offer thoughtfully developed, technical courses that explore and explain the important "basics" of metal finishing as well as the latest and most impactful developments in every specialty within the field.

Know - and grow - with help from NASF/AESF Foundation.

Let us help you with the work you do now
- and succeed with the new opportunities
in your future.

The National Association for Surface Finishing

1800 M Street • Suite 400 S • Washington, DC 20036

Phone: 202.527.0252 • Fax: 202.530.0659





BECOME CERTIFIED

CEF, CAF, and MSF designations are the gold standards for finishing industry education worldwide. Certification demonstrates that the holder has the knowledge, skills and aptitude to excel on a comprehensive exam and to understand and work with the challenges of surface finishing.

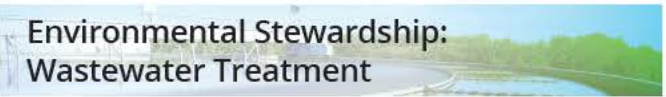
When students achieve certification, they expand their knowledge, grow within the field and evolve as true professionals. They also become members of a select group that is recognized and rewarded by employers and peers.

Certification validates a student's mastery of information and ability to meet the challenges of complex finishing environments. Each individual who achieves certification not only expands their knowledge and professional value, but raises the bar within the industry overall, making finishing more predictable, and of higher quality.

Find info and schedules
at **nasf.org/education**



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Introduction

The National Association for Surface Finishing - NASF - represents the interests of businesses and professionals throughout the surface coatings industry.

NASF's highly regarded programs and activities reflect its mission to:

- **Advance an environmentally and economically sustainable future for the finishing industry**
- **Promote the vital role of surface technology in the global manufacturing value chain.**

NASF provides a vital and active link to companies, professionals and technical experts through its events, programs, committees and communications. It serves every specialty - and every job title – within the surface finishing universe.

Membership is open to job shop and “captive” applicators, industrial users, suppliers of chemicals, equipment and services, technologists, researchers and academics.

Headquartered in Washington DC, the association conducts a robust advocacy and legislative education effort on behalf of the North American surface technology community.

AESF Education Foundation is a non-profit organization that functions as NASF's training arm. The Foundation's three core areas are education, research and scholarship. AESF Foundation was formed in 2006 and offers several distinct learning platforms: Classroom, Web-based Training, Home Study and Custom Courses, which are tailored to the individual needs of public and private entities.

AESF is the gold standard in finishing industry education, and the exclusive grantor of industry certifications, from basic CEF (Certified Electroplater Finisher) to MSF (Master Surface Finisher).

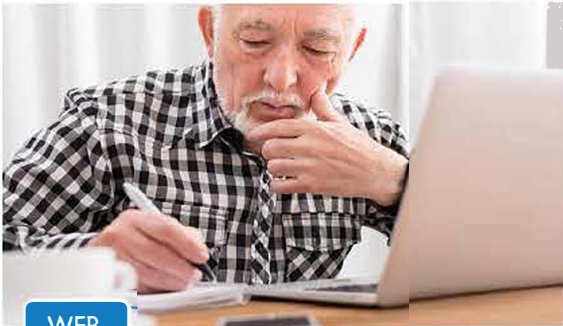


For answers to the questions we're asked most often, see center spread.

About Foundation Courses

The National Association for Surface Finishing (NASF/AESF Foundation) offers technical education to advance the science and technology of surface finishing.

Choose from 4 Study Platforms:



WEB-BASED

Web-Based Courses:

- Foundation courses in a series of web-based sessions
- Live, online interaction with NASF/AESF Foundation instructors and other industry experts
- Sessions take place on pre-determined Tuesdays & Wednesdays between 12:00 PM and 2:00 PM EST
- Session recordings are available to students for 30-days after the original posting date



HOME STUDY

Home Study Courses:

- Begin a Home Study anytime and at your own pace
- Hard copy materials include lessons and homework
- Technical Education Director responds to questions about material, grades, homework and offers suggestions to improve work
- Proctored exams at your location are also available



CLASS ROOM

Classroom Courses:

- Live interaction with instructor in a classroom setting
- Instruction takes place over 2-4 days (add 1 day for optional exam)
- Taught in select locations throughout the U.S.



Custom Courses:

- Design your own course to meet your company needs
- Mix and match 110 available course modules
- No travel required; we come to you
- Host a course at a time of your choosing

Registration is easy – and all online!
Go to nasf.org/education/course-calendar

Help with registration or want more info?
Contact NASF/AESF Foundation:
202.527.0252 | info@nasf.org

Prerequisites

Students should have at minimum a high school diploma. Some experience in processing parts for surface finishing is helpful but not required. The training materials and instruction are in English. In many cases, metric and/or US/English units of measurement are used. Students are taught how to convert between the two systems of measurement.

Course Materials

Students who participate in NASF/AESF Foundation courses will receive a binder containing full-color printed course materials. These materials will be used in conjunction with the instructor's presentation. Students can keep the course materials for independent study and future reference.

Following each lesson, a brief review quiz is presented. This helps students identify their level of understanding of key concepts, and prepare for the optional associated examination.





Airline & Aerospace Finishing

The course consists of 21 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for employees and supervisors working in Airline/Aerospace OEMs, aircraft rework facilities, Naval, Army, Marine and Air Force rework facilities and suppliers to the airline/aerospace industry.

Goal:

The goal of this course is to provide the student with a broad range of information related to metal finishing operations that are common in the Airline/Aerospace industry.

Course Description Part 1

1. Electroplating Basics

This lesson presents basic chemistry, electrochemistry and electricity principles. It introduces the student to the concepts of atomic structure, valence, atomic and molecular weights, pH, and chemical equations. Students will also learn how to make basic electroplating calculations such as plating time, current density, and area of parts.

2. Corrosion of Metals

This lesson provides basic corrosion principles related to a variety of corrosion mechanisms, including chemical attack, galvanic corrosion, stress corrosion cracking, filiform corrosion, and fretting corrosion. A discussion of the corrosion of commonly employed electrodeposits, including cadmium, copper, hard chromium and nickel is provided.

3. Hydrogen Embrittlement

This lesson will cover basic principles involved in the creation and elimination of hydrogen embrittlement effects of high strength-low alloy steels. Covered are:

- Hydrogen embrittlement mechanism
- Mitigation methods
- Operational conditions that minimize the problem

4. Metals & Alloys Used in Aerospace

Issues related to the types of parts processed and the types of alloys that they are made from are detailed here. HSLA Steels, Stainless Steels, Aluminum alloys, high temperature alloys, titanium and magnesium are covered. A review of hydrogen embrittlement causes and remedies is also provided.



Airline & Aerospace Finishing

5. Chemical Surface Preparation of Substrates for Plating

In this lesson, students will learn various methods of cleaning parts prior to plating and other finishing processes.

Included are:

- Vapor Degreasing
- Acid Pickling & Etching
 - Sulfuric Acid (70% v/v)
 - Sulfuric-Hydrofluoric Acid Immersion or Anodic Etch
 - Nitric-Hydrofluoric Acid Immersion or Anodic Etch
 - Hydrochloric Acid (Immersion/ Electrolytic Treatments)
 - Chromic Acid (Reverse Etch)
- Alkaline Electrocleaning (Immersion/Anodic/Periodic Reverse Treatments)
- Preparation Methods for:
 - Steel
 - Stainless Steels
 - High Strength Steels Bronze
 - Nickel-based Super Alloys
 - Chromium-plated Surfaces
 - Nickel-plated Surfaces
 - Aluminum
- Strike Solutions
 - Woods Nickel Chloride Strike
 - Sulfamate Nickel Chloride Strike
 - Copper Cyanide Strike
 - Silver Strike

6. Mechanical Surface Preparation

This lesson covers mechanical means of preparing parts for surface finishing. Included are:

- Dry Abrasive Blasting
 - Aluminum Oxide
 - Glass Beads
 - Plastic Media
- Vapor Blast (Vapor Honing)
- Pumice/Scotch Brite - Hand Scrub

7. Masking Techniques

This lesson covers methods employed for selective plating. Included are:

- Lacquers
- Waxes
- Tapes
- Hot Melts
- Proprietary Films
- Plated metal or Anodic films
- Permanent Masking methods





8. Quality Conformance Testing

This lesson covers the most common QA/QC tests used in aerospace:

- Hydrogen Embrittlement Testing
 - Tensile
 - Step
 - Lawrence Gauge
- Adhesion
- Salt Spray
- Hull Cell
- Surface Tension Measurements
- Plating Thickness
- Copper Sulfate Testing for Passivation
- Stress Tests
- Hardness
- Ductility
- Porosity
- Cleanliness
- Surface Temper Inspection
 - Nital Etch
 - Ammonium Persulfate Etch

9. Plating Solution Maintenance

This lesson details the most common methods of maintaining and purifying electroplating solutions, including:

- Filtration
- Carbon Treatment
- Chemical Additions
- Solution Analysis
- Electrolytic Treatments

10. Chem Film

This lesson provides guidance for processing parts to achieve a high-quality chem film coating on these substrates:

- Aluminum Alloys
- Magnesium Alloys
- Cadmium Alloys

11. Zinc and Manganese Phosphating

This lesson provides operational and troubleshooting guidance for zinc and manganese phosphate coatings applied in the aerospace industry.



Airline & Aerospace Finishing

Course Description [Part 2](#)

12. LHE Zinc-Nickel Alloy Plating

This lesson provides chemistry, operation and troubleshooting guidance for the zinc-nickel plating process designated by Boeing as an alternative to the low embrittlement cadmium plating process.

13. Cadmium Ti-Cad and Nickel-Cad Diffused Coatings

This lesson will provide the chemistry, operational conditions, purification and troubleshooting of cyanide cadmium plating processes used in aerospace finishing.

14. Copper & Silver Plating

This lesson will provide the chemistry, operational conditions, purification and troubleshooting of cyanide copper and cyanide silver plating processes as used in aerospace finishing. Also included is guidance on operating strike solutions.

15. Sulfamate & Nickel Strike Plating

This lesson provides the chemistry, operational conditions purification and troubleshooting of sulfamate nickel plating processes as used in aerospace finishing. Also included is guidance on operating nickel strike solutions.

16. Hard Chromium Plating

This lesson will provide the chemistry, operational conditions purification and troubleshooting of commonly used hard chromium plating processes.

17. Anodizing Aluminum

This lesson covers the major anodizing processes used in aerospace, including Type I Chromic, Type II-Sulfuric, Type III Hardcoat and alternates to chromic such as thin film Sulfuric Type IIB, and Sulfuric-boric Type IC. Solution chemistries, best operational practices and control practices are covered.

18. Electroless Nickel Deposition

This lesson provides the chemistry, operational conditions purification and troubleshooting of electroless nickel plating processes used in aerospace finishing.

19. Brush Plating

This lesson will provide operational guidance for obtaining sound plated deposits on selected areas of a part by using brush plating methods.

20. Stripping

This lesson covers the chemistry and operational conditions used in stripping typical aerospace coatings.

21. Thermal Spray & PVD

This lesson will provide basic information on the most common alternatives to electroplating:

- HVOF Spray
- Vacuum Deposition





Aluminum Finishing

The course consists of 11 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for employees and supervisors who work in captives or job shops that perform anodizing and other finishes on aluminum.

Goal:

The goal of this course is to provide the student with a broad range of information related to metal finishing operations that are used on aluminum.

Course Description

1. The Metallurgy of Aluminum

This lesson presents the basic properties of aluminum along with a description of the major methods used to produce parts from aluminum, including their impact on finishing.

Students will learn about forging, die casting, stamping, extruding and drawing of aluminum. Also covered is the subject of alloying elements and their impact on the surface finish following anodizing. The differences between 1000, 2000, 3000, 4000, 5000, 6000 and 7000 series alloys are detailed.

2. Mechanical Finishing of Aluminum

This lesson covers mechanical means of finishing aluminum parts, including grinding, polishing, buffing, vibratory finishing, shot peening and blasting. The differences between various polishing compounds / media are provided along with a basic understanding of the differences between polishing hardware.

3. Preparing Aluminum for Anodizing and Plating

This lesson details the steps used to prepare aluminum for anodizing or chem film (chromate) conversion coating. Cleaning via ultrasonic, chemical soak, and electro-cleaning is discussed. Special attention is given to the use of deoxidizing solutions and various acid dip mixtures. Newer technologies such as the use of biological cleaners are also provided. A significant amount of material on the zincate process for plating on aluminum is included in this lesson.

4. Aluminum Bright Dips and Electropolishing

This lesson covers the various solutions and methods used to brighten the surface of aluminum prior to finishing. Included is a discussion of electropolishing equipment and phosphoric-sulfuric electropolishing solutions. The section on bright dipping covers equipment solutions and process troubleshooting.

5. Etching and Chemical Milling of Aluminum

In this lesson, students will be provided with an overview of the various methods of etching and chemical milling of aluminum using alkaline and acidic solutions, with emphasis on etching and chemical milling using sodium hydroxide.

Operational conditions that affect etching and milling rates, and the ultimate dimensions of the parts are provided. The hazardous nature of the etching process

Aluminum Finishing

is discussed, with an example of a hydrogen explosion related to an etching process at a European anodizing facility.

6. Equipment Requirements for Anodizing

This lesson covers design issues related to the individual components of an anodizing process, including tanks, rectification, cathodes, filtration, racking, agitation systems, and process ventilation. A brief discussion of coil anodizing and brush anodizing is also part of this lesson.

7. Sulfuric Acid Anodizing of Aluminum

This lesson covers the MIL-A 8625 Type II anodizing process. Solution make-up and operational conditions including the role of impurities are discussed in detail. Common problems with the process and possible solutions are also provided.

A brief discussion on methods used to measure and monitor anodic thickness and weight of coatings is also covered. A section on “keys to successful bright anodizing” may be of special use to decorative anodizing facilities.

8. Coloring and Sealing of Anodized Aluminum

This lesson provides guidance for coloring anodic coatings using immersion dye, electrolytic methods and integral (two step) color anodizing. Operational conditions for obtaining the best results are provided as well as a discussion of the merits of each technique.

The lesson also provides descriptions of the most popular methods of sealing anodic coatings, including nickel acetate, hot water and dichromate sealing along with more recent developments such as low temperature sealing and two-step sealing. A discussion of seal quality tests is also provided.

Decorative anodizers will find the “keys to successful dyeing” and “keys to successful nickel salt sealing” sections very useful in focusing on the most important operational variables in a dye tank.

9. Hardcoat & Alternate Anodizing Solutions

This lesson will detail the most common methods for obtaining MIL-A 8625 Type III coatings. Included are the Martin, MAE, Hardas, Sanford and Metalast hard coating processes. A discussion of operational parameters affecting wear resistance is provided. The Taber Abrasion resistance test is also discussed, along with a brief discussion of alternate hardcoat anodizing solutions.

10. Anodizing Aluminum in Chromic Acid and Alternate Solutions

This lesson details the MIL-A 8625 Type I (chromic acid), LC (sulfuric-boric acid) and LLB (thin film sulfuric acid) anodizing processes. Solution make-up, operational conditions and a discussion of the role of impurities are included, along with the different results obtained from various alloys.

11. Conversion Coatings on Aluminum

This lesson provides operational and troubleshooting guidance for processes that produce chromate type (Alodine® and Iridite®) films on aluminum. Solution makeup and operational conditions for maximizing results are provided. Discussion of the causes of salt spray failures, European WEEE and RoHS initiatives and available non-chromated conversion coatings are explored.



este curso está disponible en español

Chromium Plating for Engineering Applications (Hard Chrome)

The course consists of 10 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for operators and supervisors of job shops and captive shops performing hard chromium plating operations on a variety of substrates. The course can also benefit sales personnel at hard chromium chemical and equipment suppliers.

At the conclusion of this course, attendees can expect to:

- Have a basic understanding of chemical and electrical principles as they relate to hard chromium plating.
- Be able to apply Faraday's law in calculating the time required to obtain a target thickness of chromium plate.
- Know the basics of the chromium plating process, including equipment, operational conditions and the role of impurities.
- Be aware of methods for reducing contamination from the plating process.

- Know the types of analytical procedures employed to monitor the hard chromium plating process.
- Be able to identify the causes of common plating related problems and their solutions.
- Be prepared to take the examination which is part of the Foundation MSF Certification Program.

Course Description

1. Chemistry for Hard Chromium Platers

This lesson covers the basic chemistry principles needed to better understand the plating process. The lesson begins with the structure of an atom and builds upon that basic information to yield an understanding of chemical reactions as they may be employed to process parts for plating, the plating process itself, and post-plating processes as well.

2. Electricity for Hard Chromium Platers

This lesson discusses basic principles in electricity, beginning with Ohm's Law. Basic rectification principles, how ammeters and voltmeters work, and how current is distributed over a part are important concepts delivered by this lesson. A special focus is given to the use of shields, robbers, bipolar anodes and auxiliary anodes as a means of more evenly distributing current.

3. Electrochemistry for Hard Chromium Platers

This lesson begins with Faraday's Law and shows how it can be used to predict plating time. The lesson then goes on to the Electromotive Force Series, how the corrosion behavior of metals can be predicted, and how the EMF series can explain processes such as zincating of aluminum prior to chromium plating. The concepts of polarization in plating and factors affecting deposit structure are also covered.

Chromium Plating for Engineering Applications (Hard Chrome)

Course 3

4. Equipment for Hard Chromium Plating

This lesson provides information on the equipment used for hard chromium plating, including tanks, bus bars, racks, rectifiers, agitation systems, process heating/ cooling and anodes. A special focus is placed on anode condition and maintenance, along with proper ventilation practices and emission controls.

5. Masking Techniques

This lesson covers the various methods employed to selectively plate chromium. Masking methods such as stop-off lacquer, waxes, tapes, permanent masks, and high temperature melts and solvent-based commercial dip maskants are described and discussed, along with the advantages and disadvantages of each. A brief discussion on use of conforming anode-mask combinations and out-of-tank plating as a way to minimize masking is also provided.

6. Mechanical Surface Preparation

This lesson covers physical methods used to prepare a surface for plating, including wet and dry blasting, grinding, polishing, shot peening, and honing. A brief discussion on methods used to repair damaged surfaces prior to plating (dot welding, heavy nickel build-up) is also provided.

7. Chemical Surface Preparation

This lesson covers the chemical methods used to prepare a surface for plating, including the role of alkaline cleaners, zincating of aluminum, and reverse etching methods of various metallic substrates, such as copper, steel, tool steel, stainless steel, electroless nickel, parts that have been chromium plated, and cast iron.

8. Basic Chromium Plating Principles

This lesson discusses the three major types of hard chromium plating processes (conventional, fluoride and non-fluoride mixed catalyzed baths).

Chemical make-up and operational conditions for each process are provided. The lesson also focuses on the mechanism of deposition of hard chromium and how various structures are obtained (thin-dense, for example). Another special focus is hydrogen embrittlement, its causes and cures.

9. Analysis & Control of Chromium Plating Solutions

This lesson will provide guidance on analytical procedures that are used to determine the concentration of the main ingredients and impurities in hard chromium plating solutions. It also shows how to calculate chemical additions to the process and how surface tension can be measured. Another focus is Hull Cell testing and hardness measurement.

10. Troubleshooting & Purification of Chromium Plating Solutions

This lesson describes the most common hard chromium plating defects, their potential causes and possible solutions.



Corrosion & Salt Spray

The course consists of 7 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for operators of accelerated corrosion tests and supervisors of metal finishing shops and captive shops that have in-house corrosion testing capability or that outsource testing to outside laboratories. The course is also beneficial to sales personnel serving the metal finishing industry, as it covers valuable information about the corrosion resistance of various coatings.

Goal:

The goal of this course is to provide the student with a general knowledge of common corrosion mechanisms, how they are employed in accelerated corrosion tests, and best operating practices for conducting accelerated corrosion testing.

At the conclusion of this course, attendees can expect to:

- Understand basic corrosion mechanisms involved in accelerated corrosion tests.
- Understand the levels of corrosion protection afforded by commonly applied electroplated deposits.
- Understand equipment used for salt spray and other accelerated corrosion tests, along with best operating practices.
- Know how to properly prepare test specimens for accelerated corrosion test exposure.
- Have a basic understanding of the differences between the common alternative accelerated corrosion tests such as CASS, Corrodokote, Acetic Acid and Kesternich tests.
- Be able to identify and correct the most commonly encountered causes of salt spray failures.
- Be prepared to take the examination, which is part of the Foundation MSF certification program.

Course Description

1. Corrosion Principles, Tests & Design for Corrosion Protection **Part 1**

This lesson begins by identifying the most common mechanisms for the onset of corrosion. The lesson then describes the galvanic/Electromotive Force Series of metals and how they apply to corrosion of plated parts. The concept of galvanic corrosion cells is further developed to include stressed metal corrosion mechanisms. Students are taught how these mechanisms are incorporated into accelerated corrosion test chambers. How various coatings may or may not afford sacrificial corrosion protection is a main focus of this lesson.

Corrosion & Salt Spray

2. Corrosion Principles, Tests & Design for Corrosion Protection **Part 2**

In part 2 of this lesson, differential oxygen concentration corrosion, fretting corrosion, and stress corrosion cracking are covered. A secondary focus of this lesson is the design factors that go into a part that successfully resists (or fails) corrosion tests. The lesson also covers ASTM B456 requirements for electroplated copper-nickel-chromium deposits.

3. Equipment for Salt Spray Testing

This lesson provides equipment guidelines for conducting accelerated corrosion testing with a focus on the salt spray test. Each major component, from the cabinet to the spray nozzle is described in detail along with the differences in design between various suppliers.

4. Salt Spray Cabinet Maintenance & Operation

This lesson provides a detailed look at operational conditions that can affect test results. Special attention is given to monitoring chamber conditions and recordkeeping.

5. Preparing, Exposing & Evaluating Parts

This lesson explores the most often mentioned question regarding salt spray testing; “how should parts be masked, exposed and evaluated?” Numerous examples are provided. Students are also taught how to handle parts before and after testing, and how to recognize surface corrosion.

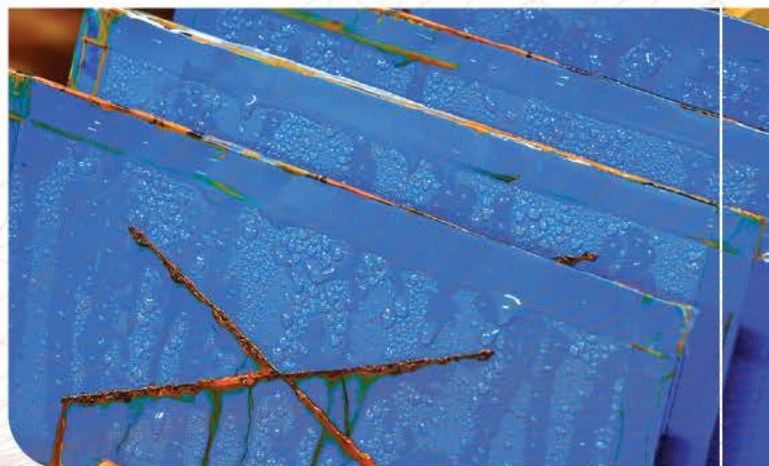
6. Alternate Accelerated Corrosion Tests

This lesson provides basic information on other accelerated corrosion tests, including CASS, Corrodokote, Acetic Acid, and Kesternich tests, with a special focus on the increasingly popular CASS (Copper Accelerated Slat Spray) test. An important part of this lesson is how to conduct a corrosivity test on a CASS test chamber. Equipment and operational differences between the alternate and the salt spray test are also given.

7. Salt Spray Failures

The salt spray test may indicate a coating failure, even when the coating has been properly applied. This is most commonly found on aluminum test panels that have been conversion coated and on boric sulfuric anodized aluminum test panels processed per aerospace specifications.

This lesson explores the potential causes of failures including problems in conducting the test, problems with the test panels and problems on the processing lines. The lesson focuses heavily on operational conditions that can easily be overlooked—wrong exposure angle, for example.



Electroforming

The course consists of 8 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for employees and supervisors working in both captive and job shops performing electroforming using nickel or copper. Trainees should have at minimum a high school diploma.

Some experience in processing parts for surface finishing is helpful but not required. Line operators, managers, technical sales representatives, any personnel serving in the electroforming industry will benefit from attending this course.

Goal:

The goal of this course is to provide the student with a broad range of information related to electroforming operations that are commonly conducted on a variety of mandrels.

The lessons in this course will prepare students for a certification examination and the opportunity to demonstrate their knowledge of electroforming methods, techniques and processes. At the conclusion of this course, attendees can expect to learn:

- Objectives and limitations of the electroforming process.
- The relationship between electrochemical principles and electroforming.
- Operational conditions for nickel electroforming solutions.
- Operational conditions for copper electroforming solutions.
- Conditions affecting the mechanical properties of nickel electroforms.
- The types of mandrels employed for electroforming.
- Example applications of electroforming.

Course Description

1. Introduction to Electroforming

This lesson introduces the process of electroforming starting with a definition of the process and reviewing its capabilities and limitations. A comparison of nickel vs. copper is made, and other deposits such as iron, silver and gold are discussed.

2. Electrochemistry for Electroforming

This lesson covers electrochemical principles that can affect the quality and rate of electroforming. Calculation of plating time using Faraday's Law equations and calculation of plating efficiency are covered in detail. Use of conforming anodes, masking,

Electroforming

and shielding are also discussed. A focus on current distribution/throwing power and how they affect deposit structure is also provided.

3. Sulfamate Nickel Plating **Part 1**

This lesson will provide the chemistry, operational conditions purification and troubleshooting of sulfamate and Watts nickel plating processes as used in electroforming operations. Focusing on plating equipment, solution make-up, solution impurities, stress measurement and control and the function of ingredients.

4. Sulfamate Nickel Plating **Part 2**

This second part of sulfamate and Watts nickel plating processes focuses on the effect of operational conditions such as temperature, pH, current density, additives, and impurities upon the electroformed deposit. A brief discussion of nickel-cobalt and nickel-manganese alloy deposits are also provided.

5. Mandrels: Types, Materials, Design and Preparation

In this lesson, students will learn the various types and designs of mandrels used in electroforming. Included are discussions on permanent mandrels made of stainless steel, copper/brass, steel, nickel, and exotic mandrel materials such as Invar® and Kovar®.

Expendable mandrels such as wax, zinc, aluminum, plastics and glass are also covered. Preparation methods, backing methods and examples of design issues are discussed.

6. Copper and Gold Electroforming

The main topic of this lesson is the use of acid copper plating solutions to produce copper electroforms. Solution chemistry, operational conditions and impurity control are detailed. A brief discussion of gold deposition for electroforming from sulfite and other high-speed gold plating solutions is also included.

7. Electroforming Applications **Part 1**

This lesson provides real-life examples of products produced via electroforming in the past and at present. Items including DVD, Compact Discs, printing screens, sieves and holograms are discussed.

8. Electroforming Applications **Part 2**

This lesson provides real-life examples of products produced via electroforming in the past and at present. Items including automotive molds, jewelry, aerospace parts such as radar wave guides and printing plates are discussed.



Electroless Deposition

The course consists of 11 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for employees and supervisors working in both captives and job shops performing electroless nickel plating. Line operators, managers, technical sales representatives and engineers who work in the job shop, captive shop electroplating or in the airline / aerospace industry will benefit from this training program.

Goal:

The goal of this course is to provide the student with a broad range of information related to electroless nickel plating operations that are commonly conducted on a variety of substrates.

At the conclusion of this course, attendees can expect to:

- Understand the properties of electroless nickel deposits.
- Be able to better understand and specify equipment used for electroless nickel plating.
- Know the cleaning/preparation processes for a wide range of substrates that are typically electroless nickel plated.

- Have a stronger knowledge of the chemistry of electroless nickel deposition processes, including EN-P and EN-B.
- Know the impact of operational variables upon the electroless nickel deposit obtained.
- Be aware of common problems encountered with the electroless nickel plating process.
- Have a basic understanding of how electroless deposition is used in plating on plastics.
- Understand other electroless deposition processes, such as cobalt, copper, and gold.
- Be prepared to take the examination, which is part of the Foundation MSF certification program.

Course Description

1. Overview of Electroless Nickel Plating

This lesson presents an overview of electroless processes including a brief history and types of deposits available, including nickel-phosphorus, nickel-boron, composites and poly alloys. Substrate limitations and activation methods are also presented.

2. Properties of Electroless Nickel Deposits

This lesson covers mechanical properties of electroless nickel deposits, focusing on developing maximum hardness/wear resistance. Other properties such as corrosion resistance, magnetic properties, solderability and weldability are also discussed.

3. Equipment for Electroless Nickel Plating

This lesson details the equipment used for electroless deposition. Included is a discussion of tank materials, tank liners, methods of temperature control, energy conservation, pumps filters, piping racking and agitation. A brief description of automated chemistry control is also included.

Electroless Deposition

4. Pre- and Post-plate Processing in Electroless Nickel Plating, [Part 1](#)

This lesson covers the various methods of preparing metallic substrates for electroless deposition. Base metals such as zinc, titanium, molybdenum, powder metallurgy is covered in part 2 of this lesson. Also discussed are preparing non-metallic substrates, masking, and stripping and post plate heat treating procedures.

5. Pre- and Post-plate Processing in Electroless Nickel Plating, [Part 2](#)

This lesson covers the methods for preparing metallic substrates for electroless deposition. Base metals such as zinc, titanium and molybdenum, as well as powder metallurgy, are covered in this lesson. Also discussed is the preparation of non-metallic substrates, along with masking, stripping, and post-plate heat treating processes.

6. Electroless Nickel Plating Solutions

This lesson provides the chemical formulations for electroless nickel solutions and describes the role of key ingredients. Also included is a discussion of WEEE and RoHS ramifications.

7. EN Operating Variables

Operational conditions that can affect the quality of the electroless nickel deposit are detailed in this lesson. Included are the role of pH, ingredient concentrations, temperature, impurities, stabilizers, complexers, and accelerants in both Ni-P and Ni-B systems.

8. Troubleshooting EN Plating Solutions

The potential causes and fixes for operational problems such as pitting, poor adhesion, poor appearance, skip plating, high internal stress, slow deposition rate, bath instability and poor corrosion resistance are among other topics in this lesson.

9. Quality Control for EN

This lesson details the most commonly employed methods for maintaining control over an electroless nickel plating process. Instrumental methods of analysis, testing of deposit properties, alloy determination, hydrogen embrittlement, thickness testing, accelerated corrosion resistance testing, and porosity tests are included in this lesson.

10. Electroless Deposition on Plastics

This lesson provides a basic understanding of how plastics are processed and electroless nickel plated to achieve a conductive surface for the application of other plated deposits. Covered are the use of etchants, neutralizers and activation systems. Troubleshooting each of these steps is also discussed.

11. Electroless Deposition of Gold & Cobalt

This lesson provides information on electroless deposition methods for producing gold deposits using borohydride, sulfite and trivalent-cyanide-based solutions. The remainder of this lesson provides some guidance for electroless deposition of cobalt and cobalt based alloys.





Electroplating & Surface Finishing

The course consists of 21 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for operators and supervisors of job shops and captive shops performing a broad range of surface finishes on a variety of substrates. The course is also beneficial to sales personnel serving the metal finishing industry, as it will provide a level of knowledge about the processes that will allow a better understanding of customer needs.

Goal:

The goal of this course is to present a broad range of information related to the fundamentals of electroplating, and methods of preparing parts for various surface finishing processes.

At the conclusion of this course, attendees can expect to:

- Understand basic chemical and electrical principles as they relate to electroplating, anodizing and conversion coating.
- Be able to apply Faraday's law in calculating the amount of time required to obtain a target thickness of plated deposit.
- Know the cleaning/preparation processes for electroplating of common base metals.
- Understand most common methods of transporting parts through an electroplating process, including barrel, rack, continuous strip/reel-to-reel and vibratory technologies.
- Identify methods used to fabricate parts that are electroplated and potential problems caused by such fabrication methods.
- Be aware of the common corrosion mechanisms and how surface finishing helps reduce corrosion.
- Have a basic understanding of how a Hull and other test cells may be employed to monitor and control a plating process.
- Know which rinsing methods and water conservation techniques are available.
- Know what filtration technologies are employed in electroplating and in recovery of process solutions.
- Be able to identify commonly employed quality tests that may be conducted on finished parts.
- Know the basics of a wide variety of plating processes, including equipment, operational conditions and the role of impurities.
- Be aware of methods for reducing contamination from plating processes.
- Be able to identify the causes of common plating related problems and their possible solutions.
- Be prepared to take the examination which is part of the Foundation MSF certification program.

Electroplating & Surface Finishing

Course Description Part 1

1. Chemistry

This lesson covers basic chemistry principles that must be understood in order to fully comprehend the plating process. The lesson begins with the structure of an atom and then builds to yield an understanding of chemical reactions as they may be employed to process parts for plating and for plating and post-plating processes.

2. Electricity

This lesson discusses basic principles in electricity, beginning with Ohm's Law. Basic rectification principles how ammeters and voltmeters work, and how current is distributed over a part are important concepts delivered by this lesson. A special focus is given to the role of anodes and how to calculate current density.

3. Electrochemistry

This lesson begins with Faraday's Law and shows how it can be used to predict plating time. The lesson then goes on to the Electromotive Force Series, how the corrosion behavior of metals can be predicted, and how the EMF series can explain processes such as immersion deposits. The concepts of polarization in plating, current distribution and factors affecting deposit structure are then covered.

4. Metallic Corrosion

This lesson covers the basic principles of corrosion, including chemical attack, galvanic corrosion, stress corrosion cracking, filiform corrosion and fretting. The corrosion of common electrodeposits, including zinc, copper, nickel and chromium, is also discussed.

5. Part Fabrication

This lesson covers the various methods employed to produce parts and their impact upon the plating process. Included in the discussions are the types of soils produced by part manufacturing methods such as stamping, casting, forging, spin casting, drawing, extruding and powder metallurgy.

A special focus of this lesson is the subject of hydrogen embrittlement causes and cures. A brief discussion of soldering and brazing and their impact upon cleaning is also provided.

6. Barrel, Rack and Other Plating Methods

This lesson provides an overview of the basic technologies used for electroplating. The lesson begins with barrel design/features and shows how solution chemistry and operational characteristics must be changed when barrel plating vs. rack plating.

The second half of the lesson focuses on racks and rack plating issues. The last part of the lesson focuses on use of shields, robbers and other methods to modify basic current distribution conditions. A brief discussion of reel-to-reel, vibratory and brush plating is also provided.



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7. Hull Cell and Other Test Cells

This lesson provides information on the use of the Hull Cell to troubleshoot and maintain a plating process. Examples of plating problems detected by the cell are given along with a demonstration of how the cell plated after a specific treatment was made. The lesson also covers other test cells such as the Lu Cell, the Gornall Cell, the Haring Cell and the Jiggle Cell.

8. Rinsing

This lesson discusses and provides calculation methods for the major method employed to conserve water without compromising process quality, including the use of counterflow rinses, spray rinses, multiple use rinses, and drag-out rinses. The lesson also discusses measurement of rinse quality using conductivity devices.

9. Filtration & Purification of Surface Finishing Solutions

This lesson focuses on maintaining a metal finishing process through proper filtration techniques, carbon treatment, and electrolytic purification.

10. Preparing Metals for Plating

This lesson will provide guidance on preparing steel, stainless steel, copper, zinc, and aluminum alloy substrates for plating. Ultrasonic cleaning, vapor degreasing, soak cleaning, electrocleaning, descaling and acid pickling are covered. A special focus is given to the zincating of aluminum alloys.

11. Testing of Plated Deposits

This lesson describes the most common quality tests employed on plated and anodic coatings. Include are tests for thickness, adhesion, accelerated corrosion, hardness, residual stress, ductility, wear, surface roughness and hydrogen embrittlement.

Course Description Part 2

12. Zinc Plating

This lesson provides chemical make-up and operational conditions for the main zinc plating solutions in use in the metal finishing industry; alkaline non-cyanide, acid chloride and cyanide. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal/treatment are discussed for each process.

13. Chromates, Phosphates & Black Oxide

This lesson provides chemical make-up and operational conditions for chemical conversion coatings such as chromates, phosphates and black oxide. Conversion coatings over plated metals and aluminum are covered. The section on phosphating includes iron, zinc and manganese phosphate processes, while the black oxide section covers the most commonly produced coatings on steel. Equipment concerns are covered in all subjects.

14. Copper Plating

This lesson provides chemical make-up and operational conditions for the main copper plating solutions in use in the metal finishing industry; alkaline non-cyanide, acid sulfate and cyanide. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal/treatment are discussed for each process.

15. Nickel Plating

This lesson provides chemical make-up and operational conditions for the Watts nickel plating solution. Special focus is given to function of and control over individual ingredients. Common contaminants and possible methods of removal and

Electroplating & Surface Finishing

treatment are discussed for each process. The lesson also covers nickel strike solutions and why and where they are used.

16. Chromium Plating

This lesson provides chemical make-up and operational conditions for the decorative chromium plating solutions used by the metal finishing industry; trivalent and hexavalent. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed for each process.

17. Precious Metals Part-1: Silver, Palladium, Ruthenium

This lesson provides chemical make-up and operational conditions for many of the precious metals plating solutions in use in the metal finishing industry; silver, palladium, palladium nickel, and ruthenium. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed for each process.

18. Precious Metals Part-2 Gold, Platinum, Rhodium

This lesson provides chemical make-up and operational conditions for additional precious metals plating solutions not covered in part 1; gold, platinum and rhodium. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal/treatment are discussed for each process.

19. Alloy Plating

This lesson provides chemical make-up and operational conditions for commonly plated alloys such as zinc-nickel, zinc-cobalt, brass, bronze, tin-zinc, tin-cobalt, tin-lead and Alballoy®.

20. Electroless Nickel Plating

This lesson provides chemical make-up and operational conditions for both nickel-phosphorus and nickel-boron based electroless nickel plating chemistries. The section on nickel-phosphorus is divided into high, medium, medium-low and low phosphorus plating solutions.

Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed for each process. Brief discussions of electroless plating of poly-alloys and composites are also provided.

21. Anodizing

This lesson provides chemical make-up and operational conditions for anodizing of aluminum, magnesium and titanium, with a major focus on aluminum. Also covered are the subjects of coloring and sealing anodic coatings on aluminum.

Recently developed substitutes for chromic acid anodizing (sulfuric-boric and thin film sulfuric) are part of this lesson too. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed.





Environmental Stewardship: Pollution Prevention

The course consists of 10 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for operators and supervisors of job shop and captive shops performing metal finishing operations such as electroplating and or anodizing. The course can also benefit sales personnel who work for manufacturers or service companies in the pollution control industry.

Goal:

The goal of this course is to provide the student with a broad range of information related to methods of preventing pollution by employing good operating practices, recycling or substitution.

At the conclusion of this course, attendees can expect to:

- Understand the best operating practices employed in metal finishing operations.
- Be able to better understand and specify equipment used for pollution prevention and recycle.
- Know the basics of ion exchange, electrolytic, evaporative, membrane technologies used for recovery/recycling of processing chemicals.
- Be aware of methods for reducing pollution from plating and stripping processes.
- Know the types of recycle/recovery technologies that can be employed in aluminum finishing processes.
- Be aware of alternatives that may be employed to eliminate the need for electroplating.
- Be prepared to take the examination which is part of the Foundation MSF certification program.

Course Description

1. Best Operating Practices

This lesson covers the types of operational practices that can have a significant impact on the generation of waste. Topics include: analytical control of solutions, filtration design, anode bagging, drag-out reduction methods, ventilation designs that minimize energy loss, good rinse designs, how to minimize drag out in barrel plating and good housekeeping.

2. Pollution Prevention for Acids and Cleaners

This lesson discusses means by which the metal finisher can increase the life of acids and cleaners. Topics include low emission vapor degreasers,

Environmental Stewardship: Pollution Prevention

Course 8

extending the life of cleaners with lipophilic filtration, use of inhibitors in acids, acid substitution, biological cleaners and operational changes that keep cleaners and acids functioning at peak efficiency.

3. Pollution Prevention and Ion Exchange

This lesson details how ion exchange works and provides guidance in selecting the best equipment and resin for a given task. Column technology, regeneration issues and cost of operation with various types of resins is covered.

4. Electrolytic Recovery Systems

This lesson provides information on electrolytic systems for recovering the metal from spent process solutions and rinses. High and low surface area systems are covered as well as cutting edge systems such as high-speed rotating cathode systems. A brief comparison between DC and pulse rectification in electrolytic recovery is also given.

5. Evaporative Recovery Systems

This lesson covers the various evaporative recovery systems, including atmospheric, vacuum, cold vaporization and vapor recompression technologies.

6. Reverse Osmosis and Other Membrane-based Recovery Systems

This lesson provides information on high and low pressure reverse osmosis systems. Also covered are recovery systems employing electrodialysis, diffusion dialysis, ultrafiltration, nanofiltration and micro-filtration for the recovery of cleaners and acids.

7. Pollution Prevention in Plating Processes

This lesson discusses how a plating process can be operated and/or modified to minimize waste generation. Topics include substitution of less polluting plating solutions, continuous purification of hard chromium plating solutions, and contamination control. A special focus is given to pollution prevention ideas for electroless nickel and electroless copper.

8. Pollution Prevention in Aluminum Finishing

This lesson discusses technologies and operational changes that can be employed on anodizing lines. Extending the life of the anodizing process using acid sorption, ion exchange or diffusion dialysis is covered, as is crystallization to extend the life of caustic etchants. Substitutes for type I (chromic acid) anodizing are also discussed.

9. Pollution Prevention for Stripping Operations

This lesson will provide a few suggestions in select stripping operations where pollution prevention technologies may be viable.

10. Alternatives to Electroplating

Alternatives such as physical vapor deposition, HVOF Spray, Plasma Spray and Sputter Ion Plating are covered in this lesson. For each technology advantages and disadvantages are provided.





Environmental Stewardship: Wastewater Treatment

The course consists of 10 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program was developed for operators and supervisors of wastewater pretreatments systems at job shop and captive shops performing metal finishing operations such as electroplating and anodizing. course can also benefit sales personnel at wastewater treatment equipment suppliers.

Goal:

The goal of this course is to provide the student with a broad range of information related to methods for removing, neutralizing and/or destroying a broad range of pollutants found in metal finishing wastewater.

At the conclusion of this course, attendees can expect to:

- Understand the basic chemical reactions conducted in wastewater treatment.
- Be able to better understand and specify equipment used for wastewater treatment.

- Know the basic operation of pH and ORP control systems and other process instrumentation.
- Be aware of other methods of treatment that are available.
- Know the impact of operational variables upon the treated effluent.
- Be aware of common problems encountered with wastewater treatment systems and possible solutions to such problems.
- Be prepared to take the examination which is part of the Foundation MSF certification program.

Course Description

1. Chemistry of Water [Part 1](#)

This is a two-part lesson detailing the relationship between chemical principles and water quality. The first part of this lesson will provide a basic background in inorganic chemistry for wastewater treatment operators, including basic chemical reactions of waste treatment. Concepts such as specific gravity, the definition of pH, acids, bases, inorganics and organics are discussed.

2. Chemistry of Water [Part 2](#)

The second part of this lesson focuses on the water molecule. Covers are the concepts of solubility, conductivity, pH buffers, water hardness, acid base reactions and stoichiometry.

3. Water Quality

This lesson details water quality issues, focusing on the conditions that affect water quality such as TOC, COD, particulates, heavy metals and non-metallic contaminants. Disinfection using UV is covered in

Environmental Stewardship: Wastewater Treatment

Course 9

detail, along with use of rinsing technologies that reduce water usage, making wastewater treatment systems more effective. Mass and flow balances are also briefly described.

4. Introduction into Wastewater Treatment

This lesson provides information on operations and devices that are crucial to successful wastewater treatment, including pH control, ORP control, mixing, retention times and chemical feed rates. A discussion of regulations and upset response is also provided. Calculation of retention times, use of coagulants/flocculants and flow equalization are also covered.

5. Process Instrumentation

This lesson covers the instrumentation measure and control used in wastewater treatment. ORP, pH, flow rate, and conductivity measurement/control are covered in detail. Also discussed are chemical metering pumps and methods of reagent addition.

6. REDOX Treatments

This lesson provides detailed guidance for the most common methods of chemically treating wastes containing cyanide or chromium (+6). Batch and flow through treatments are discussed. Cyanide treatment via alkaline chlorination is a major focus of this lesson; ozonation is also covered. Chromium reduction via reaction with a broad range of reagents is another main focus of this lesson.

7. Alternate Treatments

This lesson provides information on the treatment of difficult-to-treat wastewater, such as chelated wastes. Treatments using ferrous sulfide, DTC, starch xanthate, bisulfites and other strong reducers such as borohydride are covered. A special focus is given to treatment protocols for electroless nickel and electroless copper rinses and spent solutions.

8. Suspended Solids Separation

This lesson discusses flocculation, clarification, sludge thickening, and filtration of chemically treated wastewater. Gravity and parallel plate/tube type clarifier design and operational parameters are discussed along with newer technologies such as microfiltration and ion exchange systems. Sludge drying and polishing system employed after clarification are also covered.

9. Carbon Treatment of Wastewater

This lesson details the use of carbon to remove organics from wastewater that is destined to be recycled back to the plating process. Guidance as to source of carbon, powdered vs. granular, and equipment for flow-through carbon treatment of wastewater is provided.

10. Treatments for Oily Wastewater

This lesson provides the generally available options for removing oily waste from wastewater. The lesson focuses on coalescing filters, dissolved air flotation, membrane-based systems, lipophilic filtration and chemical treatment followed by gravity separation.



Industrial & Precious Metals Plating

The course consists of 10 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for operators and supervisors of job shops and captive shops performing precious metals plating operations on a variety of substrates. The course is also beneficial for industry sales personnel.

Goal:

The goal of this course is to provide students with a broad range of information related to methods of preparing parts for precious metal plating and to understand each precious metals plating process, what can go wrong and how to solve plating problems.

At the conclusion of this course, attendees can expect to:

- Have a basic understanding of methods of preparing a wide range of substrates for plating.
- Have knowledge of reel-to-reel plating technologies that can be employed for precious metals plating.
- Know the basics of the sulfamate nickel plating process which is commonly applied as an under-plate for precious metal deposits.
- Know the various types of gold plating solutions and be able to distinguish the features of each.
- Know the various type of other precious metals plating processes such as palladium, palladium-nickel, silver, platinum and rhodium, their chemical make-up and operational conditions.
- Know the types of tin plating processes commonly employed in the electronics industry, their chemical make-up and operational conditions.
- Be prepared to take the examination which is part of the Foundation MSF certification program.

Course Description

1. Preparing Metals for Plating **Part 1**

This lesson will provide guidance on cleaning, acid pickling and other methods of preparing substrates made of copper, zinc, "white metal" and aluminum alloys for precious metals plating.

2. Preparing Metals for Plating **Part 2**

This lesson will provide guidance on cleaning, acid pickling and other methods of preparing substrates made of ferrous, nickel, and other alloys for precious metals plating.

Industrial & Precious Metals Plating

3. Reel-to-Reel Plating

This lesson details the technologies employed in conducting continuous reel-to-reel plating systems. Included are discussion on the equipment, high speed plating issues and how to calculate the maximum line speed when multiple layers of plating must be applied. A special focus is given to techniques used to apply plated deposits on a selective basis.

4. Industrial Nickel Plating

This lesson provides detailed guidance on the sulfamate nickel plating process, including chemical make-up, operational conditions, and impurity control. There is special focus on the impact of impurities on internal stresses in the nickel deposit. Alloys of nickel such as tin-nickel, nickel-cobalt and nickel manganese are also covered, as are strike solution formulations and their use.

5. Gold Plating

This lesson covers the major gold plating processes, including cyanide, acid, and neutral formulations. Chemical make-up, equipment, operational conditions and impurity control are major topics in this lesson. A special focus is given to the subject of how to minimize porosity in gold deposits.

6. Decorative Gold Plating

This lesson will provide detailed information on decorative gold plating especially for jewelry applications. Significant time is devoted to the discussion of coloration in gold alloy plating. Another focus of this lesson is plating gold from the sulfite process.

7. Silver Plating

This lesson will provide detailed information on silver plating for jewelry and electronic applications. The lesson covers chemical make-up and operational conditions for both cyanide and non-cyanide-based silver plating solutions. Significant time is devoted to the discussion of carbonate generation and treatment.

8. Palladium, Palladium-Nickel, Platinum and Rhodium Plating

Each of the titled plating processes is covered, from chemical make-up to operational conditions. A special focus is a comparison of each process and deposit with the others.

9. Tin Plating

This lesson covers tin plating from acidic and alkaline processes. Chemical make-up and operational conditions are the main focus of this lesson. A discussion of the causes and prevention of tin whiskers is provided, along with anode filming methods for the alkaline process. A focus of this lesson is solderability issues as they relate to tin and bright tin deposits.

10. Alternatives to Electroplating

Alternatives such as physical vapor deposition, HVOF Spray, Plasma Spray and Sputter Ion Plating are covered in this lesson. For each technology advantages and disadvantages are provided.





WEB-BASED

Plating Essentials

The course consists of 9 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized - designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program benefits individuals who have no experience or training in the art and science of electroplating. Examples are new hires for plating line work, inexperienced supervisors, sales personnel serving metal finishers, and managers who want a non-technical/low technical primer in the subject. This training is also a valuable introductory course for individuals who intend to go further, with more advanced training courses.

Goal:

The goal of this course is to provide greater comfort with terminology, knowledge of coating differences and process equipment used in electroplating operations.

At the conclusion of this course, attendees can expect to:

- Understand the finishes commonly applied by the electroplating process and the basic differences in performance among the various coatings.
- Have a basic level of understanding of math, electricity, chemistry and electrochemistry as it relates to the electroplating process.
- Be able to identify and describe the main components in an electroplating process.
- Know the various types of parts and problems that each can pose when processed by electroplating.

Course Description

1. Plating Calculations

This lesson teaches basic math skills that allow students to understand the concepts of current density and the relationships between current density, plating time and plating quality.

2. Introduction: Chemistry, Electricity and Electrochemistry

This lesson provides a non-technical look at the chemistry involved in the production and operation of electroplating solutions. This lesson will also provide a non-technical look at the subjects of electricity and electrochemistry, as they are involved in the production and operation of electroplating solutions.

Plating Essentials

3. Electroplating Equipment

Students become familiar with the equipment that makes up a plating line and individual plating tanks and their function. The importance of the proper use and maintenance of each of the following equipment is detailed:

- Plating Lines
- Plating Tanks
- Anodes
- Rectifiers and Electrical Connections
- Heating & Cooling
- Filtration & Agitation
- Air Handling/Exhaust

4. Rack & Barrel Plating

The basic construction of a plating rack and the importance of each feature is a focus of this lesson. The importance of proper racking methods and care/maintenance of plating racks are also covered. The use of shields and robbers is another focus of this lesson.

The basic construction of a plating barrel and the importance of proper barrel loading, care and maintenance of barrels are discussed.

5. Types of Plated Parts

Why certain metals/parts require special attention and processing is the main focus of this lesson. Also covered are commonly encountered plating problems posed by parts made of steel, stainless steel, aluminum, zinc and copper/copper alloys.

6. Preparing Parts for Plating

This lesson provides a basic understanding of primary methods employed to prepare parts for plating. Included in this lesson are soak cleaning, electrocleaning, acid pickling, etching and descaling. Why these operations are critical to the quality of the plated parts is the main focus of this lesson.

7. Popular Plating Processes

Students are provided with operational information on common plating processes, including zinc, zinc alloy, decorative nickel, functional nickel, decorative chromium, hard chromium, copper and silver plating.

8. Common Plating Defects

This lesson focuses on the causes, effects and prevention of contamination of the plating solutions covered in lesson 7.

9. Stripping

This lesson focuses on best operating practices for conducting stripping operations.



Zinc - Zinc Alloy Plating

The course consists of 10 lessons. Each one contains a wealth of valuable, practical information. And if you score 70 or above on the optional exam, you'll receive 1 credit toward certification as a Master Surface Finisher. MSF is the world's most respected – and most widely recognized – designation for finishing industry professionals. Those passing 6 course exams earn the coveted MSF designation.

Who Benefits?

This training program is beneficial for operators and supervisors of job shops and captive shops performing zinc and zinc alloy plating operations. The course is also beneficial for industry sales personnel.

Goal:

The goal of this course is to provide students with information related to the metallurgy and corrosion behavior of zinc coatings. Students will also learn the differences between the various zinc plating and zinc alloy plating processes, including potential problems and how to prevent and solve them.

The lessons in this course prepare students for a certification examination designed to demonstrate knowledge of technologies used in precious metals plating.

At the conclusion of this course, attendees can expect to:

- Understand the basic behavior of zinc and zinc alloys in retarding the onset of corrosion in steel and other base metals.
- Have knowledge of the metallurgy and basic chemical principles involved in zinc and zinc alloy plating.
- Understand how barrel plating is different from rack plating.
- Know the various types of zinc plating solutions and be able to distinguish the features of each.
- Understand zinc alloy plating processes including zinc-nickel, zinc-cobalt, tin-zinc, and tin-zinc-copper, their chemical make-up and operational conditions.
- Be prepared to take the examination, which is part of the Foundation MSF certification program.

Course Description

1. Electroplating Basics for Zinc Platers

This lesson provides basic chemical, electrochemical and metallurgical background that will allow the student to make basic calculations of current density and plating times for both rack and barrel plating of zinc and zinc alloys.

2. Introduction-Historical Development & Applications of Zinc Coatings

This lesson provides an introduction to zinc coatings from a historical perspective, followed by a discussion of economics, corrosion mechanisms, and methods used to apply zinc coatings (mechanical plating, electroplating, hot dip galvanizing and fake diffusion processes).

Zinc - Zinc Alloy Plating

3. Preparing Parts for Zinc Plating & Post Plate Baking

This lesson will provide guidance on preparing substrates for zinc plating. Covered are ultrasonic cleaning, vapor degreasing, soak cleaning, electrocleaning, descaling and acid pickling.

4. Cyanide Zinc Plating

This lesson provides chemical make-up and operational conditions for the cyanide-based zinc plating solutions in use in the metal finishing industry. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed.

5. Alkaline Non-Cyanide Zinc Plating

This lesson provides chemical make-up and operational conditions for the alkaline non-cyanide based zinc plating solutions used in the metal finishing industry. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed.

6. Chloride Zinc Plating

This lesson provides chemical make-up and operational conditions for the acid chloride-based zinc plating solutions used in the metal finishing industry. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal/treatment are discussed.

7. Zinc Alloy Plating Part 1: Zinc-Nickel

This lesson provides chemical make-up and operational conditions for the alkaline and acidic zinc nickel plating solutions used in the metal finishing industry. Special focus is given to the function of and control over the individual components of common contaminants and possible methods of removal and treatment.

8. Zinc Alloy Plating Part 2: Zinc-Cobalt

This lesson provides chemical make-up and operational conditions for the alkaline and acidic zinc cobalt plating solutions used in the metal finishing industry. Special focus is given to the function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed.

9. Zinc Alloy Plating Part 3: Zinc-Iron

This lesson provides chemical make-up and operational conditions for the alkaline and acidic zinc iron plating solutions in use in the metal finishing industry. Special focus is given to function of and control over individual ingredients in each process. Common contaminants and possible methods of removal and treatment are discussed.

10. Chromate Conversion Coatings Over Zinc and Zinc Alloys

This lesson provides chemical make-up and operational conditions for hexavalent and trivalent chemical conversion coatings for zinc and zinc alloy deposits. A major focus is good operating practices that produce the highest level of corrosion resistance.



Course Calendar & Tuition

Classroom Courses	Dates	Exam Date	Registration Deadline	Location	Member	Non-Member
Electroplating & Surface Finishing Parts 1 & 2 (CEF)	June 3, 4, 5, 6	June 7	May 20	Rosemont, IL	\$1,650.00	\$2,250.00
Aluminum Finishing	Nov. 18 & 19	Nov. 20	Nov. 4	Boston, MA	\$910.00	\$1,510.00

Home-Study Courses	Member	Non-Member
Airline & Aerospace Finishing Parts 1 & 2 (CAF)	\$1,350.00	\$1,650.00
Airline & Aerospace Finishing Part-1 Only	\$750.00	\$1,050.00
Airline & Aerospace Finishing Part-2 Only	\$750.00	\$1,050.00
Aluminum Finishing	\$825.00	\$1,110.00
Chromium Plating for Engineering Applications	\$825.00	\$1,110.00
Corrosion & Salt Spray	\$825.00	\$1,110.00
Electroforming	\$825.00	\$1,110.00
Electroless Deposition	\$825.00	\$1,110.00
Electroplating & Surface Finishing Parts 1 & 2 (CEF)	1,350.00	\$1,650.00
Electroplating & Surface Finishing Part-1 Only	\$750.00	\$1,050.00
Electroplating & Surface Finishing Part-2 Only	\$750.00	\$1,050.00
Industrial & Precious Metals Plating	\$825.00	\$1,110.00
Plating Essentials	\$825.00	\$1,110.00
Environmental Stewardship: Wastewater Treatment	\$825.00	\$1,110.00
Environmental Stewardship: Pollution Prevention	\$825.00	\$1,110.00
Zinc & Zinc Alloy Plating	\$825.00	\$1,110.00

Home-Study Course Shipping	U.S. Address	Non-U.S. Address
	\$50	\$90

Web-Based Courses	Dates	Registration Deadline	Member	Non-Member
Plating Essentials	February 5, 6, 12, 13, 19, 20	Jan. 22	\$800	\$1,130
Environmental Stewardship: Pollution Prevention	March 5, 6, 12, 13, 19, 20	Feb. 19	\$800	\$1,130
Electroplating & Surface Finishing Parts 1 & 2 (CEF)	August 6, 7, 13, 14, 20, 21, 27, 28 October 1, 2, 8, 9, 15, 16, 22, 23	July 23	\$1,300	\$1,700
Electroplating & Surface Finishing Part-1 Only	August 6, 7, 13, 14, 20, 21, 27, 28	July 23	\$800	\$1,130
Electroplating & Surface Finishing Part-2 Only	October 1, 2, 8, 9, 15, 16, 22, 23	Sep. 17	\$800	\$1,130
Plating Essentials	September 3, 4, 10, 11, 17, 18	Aug. 20	\$800	\$1,130
Electroless Deposition	November 5, 6, 12, 13, 19, 20	Oct. 22	\$800	\$1,130

* Web-Based Courses take place on pre-determined Tuesdays and Wednesdays between 12:00 PM and 2:00 PM EST.

Optional Exams	Member	Non-Member
Airline & Aerospace Finishing (CAF) Exam	\$150.00	\$250.00
Aluminum Finishing Exam	\$150.00	\$250.00
Chromium Plating Exam	\$150.00	\$250.00
Electroplating & Surface Finishing (CEF) Exam	\$150.00	\$250.00
Electroless Deposition Exam	\$150.00	\$250.00
Electroforming Exam	\$150.00	\$250.00
Plating Essentials Exam	\$150.00	\$250.00
Industrial & Precious Metals Exam	\$150.00	\$250.00
Environmental Stewardship: Wastewater Treatment Exam	\$150.00	\$250.00
Environmental Stewardship: Pollution Prevention Exam	\$150.00	\$250.00
Corrosion & Salt Spray Exam	\$150.00	\$250.00
Zinc & Zinc Alloy Plating Exam	\$150.00	\$250.00

Registration Policies

Advance Registration is Required

Registration for all NASF/AESF Foundation courses is completed at nasf.org/education/course-calendar and payment is taken at the time of reservation.

Cancellations Must Be in Writing

To receive a refund for any registrations, email info@nasf.org with your full name and course you are referencing.

Once registration and payment is made, 50% of the total amount is non-refundable.

Two weeks prior to the start of the course **No refund**

If you do not attend & do not notify Foundation **No refund**

No on-site refunds are available.

NASF Members Receive Up to 35% Off Registrations

To become a member of the NASF, visit nasf.org/join.

Payment of Registration Fee Conveys Right to Attend Only

NO video taping or recording is allowed. Circumstances may make it necessary to cancel a course or workshop or substitute other qualified instructors. Please consider this when arranging transportation; The Foundation cannot assume responsibility for non-refundable tickets. If the course or workshop is not held for any reason, the liability of The Foundation is limited to a refund of the registration fee.

To Register, Visit nasf.org/education/course-calendar

For More Information, Please Contact info@nasf.org.

Connect with
NASF online:



Custom Course Options

Flexible and Convenient

The Foundation Customized Course Series allows you to design two-to-four-day training courses that perfectly fit the needs and goals of your company, association, or public entity.

Training stimulates – *and motivates!* It also keeps workers up-to-date so they can respond effectively to the needs of the market.

Training sharpens skills, and helps develop new ones, enabling employees at every level to reach their potential, while improving the quality of their work.

Train for Success

The most successful organizations prioritize training, and make it an integral part of their culture, and their mission.

The Foundation has designed courses for the top aerospace, DOD, medical and electronic companies. A qualified Foundation instructor develops and teaches a curriculum according to your company's needs. Each module takes 45 to 90 minutes. Upon completion of the course, participants receive a certificate and an opportunity to take an optional exam. Upon passing the exam, employees will qualify for the Foundation's certification program.

The Ultimate “Win-Win”

Training and development has significant benefits for employers and employees.

Great training accomplishes these 9 goals – and more!

Enhances employee satisfaction and morale

Increases motivation

Boosts efficiencies in process, resulting in financial gain

Increases capacity to adopt new technologies and methods

Encourages innovative thinking

Reduces employee turnover

Enhances company image

Increases credibility with business partners

Improves the employer's competitive advantage

Customize to Suit the Organization

Choose any combination of lessons from the courses listed in this catalog to create a training program tailored to your specific needs. 5-6 lessons typically require one day to present.

Certified Aerospace Finisher (CAF)

demonstrates specialized knowledge in materials, plating processes, and quality control methods that are vital to airline manufacturing.

Certified Electroplater Finisher (CEF)

demonstrates a broad knowledge of surface finishing that can be applied toward positions or business with manufacturers in a variety of industries.

Master Surface Finisher (MSF)

demonstrates mastery of essential finishing processes, as well as knowledge in specialized processes and environmental stewardship.

To obtain the MSF designation, students must pass exams for the following:

Primary: (Choose 1)

- Airline & Aerospace Finishing (CAF)
- Electroplating & Surface Finishing (CEF)

Core: (Choose 3)

- Aluminum Finishing
- Chromium Plating for Engineering Purposes
- Electroforming
- Electroless Deposition
- Precious Metals Plating
- Zinc & Zinc Alloy Plating

Secondary: (Choose 2)

- Corrosion & Salt Spray
- Environmental Stewardship: Pollution Prevention
- Environmental Stewardship: Wastewater Treatment



Frank Altmayer, MSF, AESF Fellow

For 36 years, Frank Altmayer has provided expert instruction through the AESF Education Foundation. He holds a BS in Chemical Engineering, and an MS in Metallurgy from the Illinois Institute of Technology. Mr. Altmayer is Technical Education Director of the Foundation, using his half-century of experience in electroplating, metal finishing, and wastewater treatment to develop challenging and informative course materials for students at all levels of experience.



Jeffrey R. Lord, MSF

Mr. Lord is a Principal for The Black Company Environmental. He has a BS in Chemistry/Education from SUNY Cortland and an MS in Physical Chemistry from Boston College. Mr. Lord has 28 years of consulting, process engineering, EH&S management, manufacturing engineering and R&D experience. His focus areas include process design and development, process control, technology evaluation, construction, startup and commissioning, resource recovery, and waste treatment.



Doug Deeken

Mr. Deeken is a metallurgical and special processing consultant. He has a BS in Chemical Engineering from Youngstown State University. Mr. Deeken has specialized expertise in failure analysis, heat treatment, electroplating and organic finishing systems. He has 20 years of experience in aerospace, and, most notably, with aerospace *Fortune 500* OEMs. Other areas of focus include food processing, pressure vessels, automotive and polymer processing products.

Q. What is the cost of a specific course?

A. Tuition for each course is found on page 36-37.

Q. When is a specific course being offered next?

A. The course calendar with specific dates and times for Web-Based and Classroom courses is found on page 36.

Q. Where can I download the course catalog?

A. Visit nasf.org/education

Q. How does a Home Study, Web-Based, and/or In-Person platform work?

A. An explanation of these options is on page 6.

Q. How do I sign-up for a course?

A. All sign-ups are now online. Visit nasf.org/education/course-calendar

Q. Do you have any discounts?

A. There are discounts for NASF members; also, employers who sign up 5 or more employees for one course receive a 10% discount on everyone's tuition.

Q. Are the course materials electronic or hard-copy?

A. All course materials are hard-copy and will arrive prior to the start of each course.

Q. Where can I find the curriculum for a particular course?

A. The highlights for each course are outlined in the course description found in this catalog.

Q. Can I take the exam at a later date and how can I take the exam at my location?

A. Course exams can be taken at your location with a proctor. A proctor is a supervisor who already has a CEF, CAF or MSF designation or someone from human resources who can receive the hard-copy materials by mail, administer the exam, and send the completed materials back to NASF/AESF Foundation for grading.

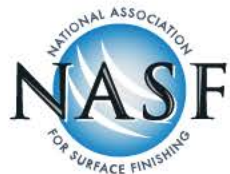
Q. What are the course requirements to obtain Master Surface Finisher (MSF)?

A. The requirements for MSF designation are found on the reverse side of this page.

Q. I'm new to the industry. What's a good place to start?

A. We recommend a basic course called Plating Essentials, a great introductory course on equipment, chemistry, plating processes and much more. It's ideal for new hires, new supervisors, sales personnel who work with metal finishers, and those in management who want a non-technical overview course. The web-based version is offered each September; you can also take it as a home study course any time. See page 32 for details.





NASF.org



2019 EVENTS

Leadership Conference

February 24 - 27, 2019
Grand Cayman Island

Washington Forum

April 15 - 17, 2019
Washington, D.C.

SUR/FIN

June 3 - 5, 2019
Rosemont, Illinois

For Details visit [NASF.org/events](https://www.nasf.org/events)