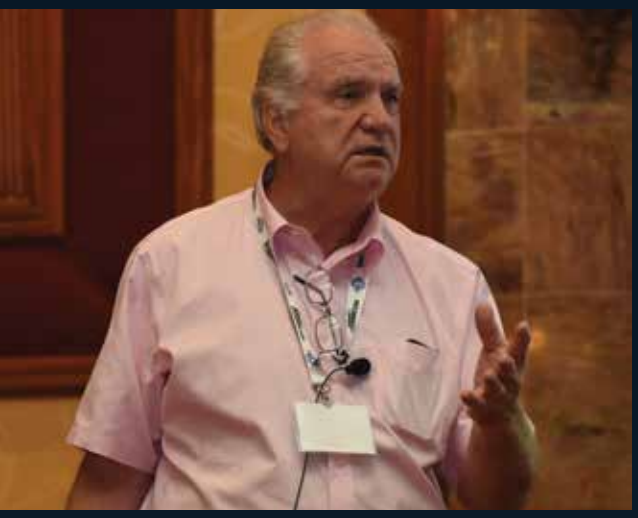

NATIONAL ASSOCIATION FOR SURFACE FINISHING
NASF

AESF FOUNDATION

2018 COURSE CATALOG

Register Today on NASF.org

Contents

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About the Foundation

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

Four Approaches to Education:

The Foundation takes a multi-pronged approach towards education to offer individuals and companies options to fit time schedules and budgets. Course offerings include:

In-Person Courses:
- Taught throughout the country
- Instruction takes place over 2-4 days (add 1 day for optional exam)
- Sponsored by the Foundation, and NASF Chapters

Web-Based Training:
- Foundation courses in a series of web-based sessions
- Live, online interaction with Technical Education Director and other industry experts
- Take place Tuesdays & Wednesdays between 12:00 PM and 2:00 PM EST.
- Course recordings are available for 30 days after sessions have ended

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

Home Study:
- Learn *any Foundation Course* at home, 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 also available

Topics Relevant To Your Needs:

- Airline & Aerospace Finishing
- Aluminum Finishing
- Chromium Plating for Engineering Applications (Hard Chrome)
- Corrosion & Salt Spray
- Electroforming
- Electroless Deposition
- Electroplating & Surface Finishing
- Environmental Stewardship: Pollution Prevention
- Environmental Stewardship: Wastewater Treatment
- Industrial & Precious Metals
- Plating Essentials
- Zinc – Zinc Alloy Plating

NASF Members Save Up to 44% off of Registration

To learn more about the NASF or become a member, visit www.nasf.org or contact Matthew Martz at mmartz@nasf.org.

To Register:

Go to NASF.org/Education

Email: mmartz@nasf.org

Fax: 202.530.0659

For More Information Please Contact Matthew Martz:
202.527.0252 | mmartz@nasf.org

Connect with NASF online:

About Foundation Courses

Education Recommendations:

Trainees 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 utilized. Students are taught how to convert between the two systems of measurement.

Course Materials:

Students are provided with a three ring binder containing printed course materials. The course materials consist of a full color reproduction of every slide in each presentation followed by text that is intended to cover and, in some cases, go beyond the live presentation given during instruction. Students can utilize these course materials for independent study and future reference.

Following each lesson a review quiz is presented to allow each student to identify their level of understanding of the more important concepts in the lesson. These quizzes also prepare the student for the associated examination.

Instructors:

Foundation instructors have several decades of field experience in surface finishing. Our instructors include consultants that have been recognized worldwide as the best in their field.

Objective:

The objective of course lessons is to prepare students for certification. Examinations will provide students with an opportunity to demonstrate their knowledge in surface finishing methods, techniques and processes, whereby quality is improved and rejects/finishing problems are reduced, making students more valuable to their employers.

Get Certified:

Increase your industry knowledge and boost your career with world-class certifications from NASF. To date, over 1,500 professionals have opened the door to new opportunities with major names in manufacturing by completing coursework designed to give students highly-desired knowledge in materials and processes vital to the finishing industry.

Certified finishers hold highly coveted positions and contracts with some of the largest brands in aerospace, automotive, and consumer products, as well as the US Air Force, Navy, and NASA. Courses are offered as a Home Study, In-Person or Web-Based, so you can determine what platform of education works best for you.

Certifications include three designations to showcase your achievements:

Certified Aerospace Finishers (CAF) can build a career or client list in the aerospace industry with specialized knowledge in materials, plating processes, and quality control methods that are vital to airline manufacturing. Students obtain a CAF designation by passing the Airline & Aerospace exam, which they can prepare for by taking the Airline & Aerospace Finishing Course.

Certified Electroplater Finishers (CEF) gain a broader knowledge of surface finishing that can be applied toward positions or business with manufacturers in a variety of industries including automotive, consumer electronics, industrial machinery and more. Students obtain a CEF designation by passing the Electroplating & Surface Finishing exam, which they can prepare for by taking the Electroplating & Surface Finishing Course.

Master Surface Finishers (MSF) demonstrate overall industry expertise by obtaining a CAF or CEF certification, plus additional coursework that reflects knowledge in specialized processes and environmental stewardship. This designation can be especially useful in discussing complex processes to prospective clients and employers across industries. To obtain the MSF designation, students must pass exams for the following:

Primary: (Choose 1)
- Airline & Aerospace Finishing (CAF)
- Electroplating & Surface Finishing (CEF)

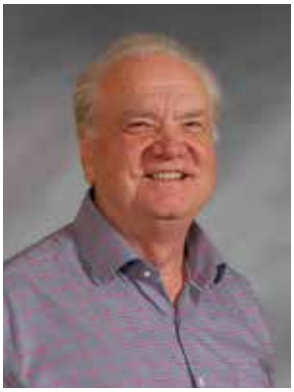
Core: (Choose 3)
- Aluminum Finishing
- Chromium Plating for Engineering Purposes
- Electroforming
- Electroless Deposition
- Precious Metals Plating
- Zinc & Zinc Alloy Plating

Secondary: (Choose 2)
- Corrosion & Salt Spray
- Environmental Stewardship: Pollution Prevention
- Environmental Stewardship: Wastewater Treatment

After passing the certification exam, your name and company will be added to our expanding list of esteemed professionals on NASF.org. In addition, you will receive a certificate to display in your home or office.

Invest in your future today! Contact Matt Martz, NASF Education Director at (202) 527-0252 or mmartz@NASF.org for more information.

Instructors



Frank Altmayer, MSF, AESF Fellow

For over thirty-five years, Frank Altmayer has been delivering expert instruction to students through the AESF Education Foundation. Mr. Altmayer attended the Illinois Institute of Technology, attaining his Bachelor's in Science for Chemical Engineering and a Master's Degree in Metallurgy. He went on to offer technical expertise to the metal finishing industry as owner of Scientific Control Laboratories, Inc. selling the company in 2007. Since 1992, Mr. Altmayer has served as Technical Education Director of the Foundation, using his forty-nine years of experience in electroplating, metal finishing, and wastewater treatment system design and troubleshooting to develop challenging and informative courses for metal platers of all experience levels. As time allows, he continues to lend his expertise as a trusted consultant to the surface finishing industry.

Jeffrey R. Lord, MSF

Jeffrey R. Lord, MSF, is Principal for the Black Company Environmental and provides consulting services for surface finishing clients to systematically and cost-effectively transform processes and plants towards the highest technical performance, quality and efficiency while improving profitability. Mr. Lord has more than 30 years of consulting, process engineering, EH&S management, manufacturing engineering and industrial R&D experience. He works principally with metal finishers and has done design, construction and set up of operations. His main focus is process control, process optimization and troubleshooting of metal finishing processes. He has worked for wide variety of private industry clients in aerospace, automotive, chemical and other manufacturing industries and for U.S. and foreign government agencies. He has been an AESF Foundation course instructor for over 25 years. He started off his career teaching high chool chemistry and physics and has been an instructor at all levels, from elementary to professional, through his career. He has a Bachelor's in Science in Chemistry/Education from SUNY Cortland (1978) and a Master's degree in Physical Chemistry from Boston College (1983).

Doug Deeken

Doug Deeken is an independent metallurgical and special processing consultant with expertise in failure analysis, heat treatment, electroplating and organic finishing systems. He has 18 years of experience with aerospace, food processing, pressure vessel, automotive and polymer processing products. His experience includes work for Aerospace Fortune 500 OEMs. He has a Bachelor's in Engineering in Chemical Engineering from Youngstown State University (1997).

Custom Course Options

It's Convenient.

The Foundation Customized Course series allows for you to design two-to-four-day training courses that fit your company's needs.

Training will keep your employees motivated and updated so they will be able to respond to the needs of the market. In addition, training will enhance their innate skills and will enable them to reach their potential while improving the quality of their work.

Fulfill Training Requirements and Maintain Certifications

If your company isn't investing in training, think about all the companies you admire as models for doing business right. You'll find they view training as an investment in their people, and that training is a part of their culture.

The Foundation has designed courses for the top aerospace, DOD, medical and electronic companies. A qualified Foundation instructor will develop and teach a curriculum according to your company's needs. Each module takes between 45 minutes to 1.5 hours to complete. Upon completion of the course, each participant will receive a certificate of completion and an opportunity to take an optional exam. Upon passing the exam, your employees will qualify under Foundation's certification program

Still Not Convinced?

Employee training and development has been shown to:

- Increase satisfaction and morale among employees
- Increase employee motivation
- Increase efficiencies in process, resulting in financial gain
- Increase capacity to adopt new technologies and methods
- Increase innovation in strategies and products
- Reduce employee turnover
- Enhance company image
- Increase credibility with business partners
- Improve competitive edge

Customization

Choose any combination of lessons from the courses listed below to create your own custom training program tailored to your specific needs. 5-6 lessons typically will require one day to present.

Menu of Lessons from Courses

Electroplating & Surface Finishing
CEF Certification and credit toward MSF Certification upon passing exam

1. Chemistry
2. Electricity
3. Electrochemistry
4. Metallic Corrosion
5. Part Fabrication
6. Barrel, Rack & Other Plating Methods
7. Hull Cell & Other Test Cells
8. Rinsing
9. Filtration & Purification of Surface Finishing Solutions
10. Preparing Metals for Plating
11. Testing of Plated Deposits
12. Zinc Plating
13. Chromates, Phosphates & Black Oxide
14. Copper Plating
15. Nickel Plating
16. Chromium Plating
17. Precious Metals Plating Part 1: Silver, Palladium, Ruthenium
18. Precious Metals Plating Part 2: Gold, Platinum, Rhodium
19. Alloy Plating
20. Electroless Nickel Plating
21. Anodizing

Aluminum Finishing
Credit toward MSF certification upon passing exam

1. Metallurgy of Aluminum
2. Mechanical Finishing of Aluminum
3. Preparing Aluminum for Anodizing & Plating
4. Aluminum Bright Dips & Electropolishing
5. Etching & Chemical Milling of Aluminum
6. Equipment Requirements for Anodizing
7. Anodizing Aluminum in Chromic Acid & Alternate Solutions
8. Type II-Sulfuric Acid Anodizing of Aluminum
9. Coloring of Anodized Aluminum
10. Sealing Methods for Anodized Aluminum
11. Hardcoat & Alternate Anodizing Solutions
12. Conversion Coatings on Aluminum

Chromium Plating for Engineering Applications (Hard Chromium Plating)
Credit toward MSF certification upon passing exam

1. Chemistry for Hard Chromium Platers
2. Electricity for Hard Chromium Platers
3. Electrochemistry for Hard Chromium Platers
4. Hydrogen Embrittlement
5. Equipment for Hard Chromium Plating
6. Masking Techniques

Custom Course Options

7. Chemical Surface Preparation
8. Mechanical Surface Preparation
9. Basic Chromium Plating Principles
10. Analysis & Control of Chromium Plating Solutions
11. Troubleshooting & Purification of Chromium Plating Solutions

Environmental Stewardship: Wastewater Treatment
Credit toward MSF certification upon passing exam

1. Chemistry of Water Part 1
2. Chemistry of Water Part 2
3. Water Quality Issues
4. Introduction to Wastewater Treatment
5. Process Instrumentation
6. REDOX Treatment Methods
7. Advanced Alternative Wastewater Treatments
8. Solid-Liquid Suspended Solids Separation
9. Carbon Treatment of Wastewater
10. Treatments for Oily Wastewater

Environmental Stewardship: Pollution Prevention
Credit toward MSF certification upon passing exam

1. Best Operation Practices for P2
2. P2 for Cleaners & Acids
3. Ion Exchange Concepts for P2
4. Electrolytic Systems for P2
5. Evaporative Systems for P2
6. Membrane Systems for P2
7. Pollution Prevention for Electroplating Processes
8. Pollution Prevention for Aluminum Finishing
9. Pollution Prevention for Stripping
10. Alternatives to Electroplating

Airline/Aerospace Finishing
CAF Certification and credit toward MSF certification upon passing exam

1. Electroplating Basics
2. Corrosion of Metals
3. Hydrogen Embrittlement
4. Metals & Alloys Utilized in Aerospace
5. Chemical Surface Preparation of Substrates for Plating Substrates
6. Mechanical Surface Preparation
7. Masking Techniques
8. Quality Conformance Testing
9. Plating Solution Maintenance
10. Chem Film
11. Zinc and Manganese Phosphating
12. LHE Zinc-Nickel Alloy Plating
13. Cadmium Ti-Cad and Nickel-Cad Diffused Coatings
14. Copper & Silver Plating
15. Sulfamate & Nickel Strike Plating
16. Hard Chromium Plating
17. Anodizing Aluminum
18. Electroless Nickel Deposition
19. Brush Plating
20. Stripping
21. Thermal Spray & PVD

Electroless Deposition
Credit toward MSF certification upon passing exam

1. Overview of Electroless Nickel Plating
2. Properties of Electroless Nickel Deposits
3. Equipment for Electroless Nickel Plating
4. Pre and Post Plate Processing in Electroless Nickel Plating, Part 1
5. Pre and Post Plate Processing in Electroless Nickel Plating, Part 2
6. Electroless Nickel Plating Solutions
7. EN Operating Variables
8. Troubleshooting EN Plating Solutions
9. Quality Control for EN
10. Electroless Deposition on Plastics
11. Electroless Deposition of Gold & Cobalt

Corrosion & Salt Spray
Credit toward MSF certification upon passing exam

1. Corrosion Principles Part 1
2. Corrosion Principles Part 2
3. Salt Spray Equipment
4. Salt Spray Cabinet Maintenance & Operation
5. Preparing, Exposing & Evaluating Parts
6. Common Salt Spray Failures
7. Alternate Accelerated Corrosion Tests

Zinc & Zinc Alloy Plating
Credit toward MSF certification upon passing exam

1. Electroplating Basics for Zinc Platers
2. Introduction-Zinc Coatings
3. Preparing Metals for Zinc Plating
4. Cyanide Zinc Plating
5. Non-Cyanide Alkaline Zinc Plating
6. Acid Chloride Zinc Plating
7. Zinc Alloy Plating Part-1: Zinc Nickel
8. Zinc Alloy Plating Part-2: Zinc Cobalt
9. Zinc Alloy Plating Part-3: Zinc Iron
10. Chromate Conversion Coatings for Zinc Plating

Industrial & Precious Metal Plating
Credit toward MSF certification upon passing exam

1. Preparing Metals for Plating, Part 1: Copper, Zinc, White Metal, Aluminum
2. Preparing Metals for Plating, Part 2: Ferrous Alloys,Nickel Alloys and Others

3. Reel to Reel Plating
4. Industrial Nickel & Nickel Alloy Plating Processes
5. Gold Plating
6. Decorative Gold Plating
7. Silver Plating
8. Palladium, Palladium-Nickel, Platinum, and Rhodium Plating
9. Tin Electroplating
10. Modern Alternatives to Electroplating

Plating Essentials

1. Plating Calculations
2. Introduction: Chemistry, Electricity and Electrochemistry
3. Electroplating Equipment
4. Rack and Barrel Plating
5. Types of Plated Parts
6. Preparing Parts for Plating
7. Popular Plating Processes
8. Common Plating Defects
9. Stripping Electroplating Deposits

Electroforming

Credit towards MSF certification upon passing exam

1. Introduction to Electroforming
2. Electrochemistry for Electroforming
3. Electroforming with Nickel-Part 1
4. Electroforming with Nickel-Part 2
5. Mandrels: Types, Materials, Design & Preparation
6. Copper and Gold Electroforming Solutions
7. Electroforming Applications-Part1
8. Electroforming Applications-Part2

Miscellaneous Lessons/Topics:

Energy Conservation

- Energy Conservation: Understanding Electric Bills
- Basic and Innovative Methods of Energy Conservation
- Energy Conservation and Rectifiers/Tanks
- Energy Conservation in Ventilation Systems
- Energy Conservation in Metal Finishing Solutions
- Energy Conservation in Lighting and HVAC

Rack Plating

- Rack Plating-Rack Design
- Current Shields, Thieves and Auxiliary Anodes

Set Up a Custom Course Today

Contact **Matthew Martz,** NASF Education Foundation **P:** 202.527.0252 **F:** 202.530.0659 **E:** mmartz@nasf.org

Airline & Aerospace Finishing

Airline & Aerospace Finishing

The course consists of 21 lessons. Students successfully completing the exam will be awarded a Certified Aerospace Finisher (CAF) certification.

Intended Audience:
This training program is designed to be 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 commonly conducted in the Airline/Aerospace industry.

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. The student is also taught 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 are 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 Utilized 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.

5. **Chemical Surface Preparation of Substrates for Plating**
   In this lesson, students will be provided with a discussion of the 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-base 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 more commonly conducted QA/QC tests utilized 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 will detail the most commonly employed methods of maintain 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 the following substrates:

- Aluminum Alloys
- Magnesium Alloys
- Cadmium Alloys

11. Zinc and Manganese Phosphating
This lesson will provide operational and troubleshooting guidance for zinc and manganese phosphate coatings, as applied in the aerospace industry.

Part 2

1. LHE Zinc-Nickel Alloy Plating
This lesson will provide chemistry, operation and troubleshooting guidance for the zinc-nickel plating process designated by Boeing as an alternate to the low embrittlement cadmium plating process.

2. 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.

Aluminum Finishing

3. **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.
4. **Sulfamate & Nickel Strike Plating**
   This lesson will provide 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.
5. **Hard Chromium Plating**
   This lesson will provide the chemistry, operational conditions purification and troubleshooting of commonly utilized hard chromium plating processes.
6. **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.
7. **Electroless Nickel Deposition**
   This lesson will provide the chemistry, operational conditions purification and troubleshooting of electroless nickel plating processes used in aerospace finishing.
8. **Brush Plating**
   This lesson will provide operational guidance for obtaining sound plated deposits on selected areas of a part by using brush plating methods.
9. **Stripping**
   This lesson will provide the chemistry and operational conditions utilized in stripping typical aerospace coatings.
10. **Thermal Spray & PVD**
    This lesson will provide basic information on the most commonly used alternatives to electroplating:
    - HVOF Spray
    - Vacuum Deposition

Aluminum Finishing

(Materials Available in Spanish)

This course consists of 10 lessons. Students successfully completing the exam will be given credit towards the Master Surface Finisher (MSF) certification.

Intended Audience:

This training program is designed to be 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 commonly conducted on aluminum.

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 after 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 utilized to prepare aluminum for anodizing or chem film (chromate) conversion coating.

   Cleaning via ultrasonic, chemical soak, and electrocleaning methods are 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/methods that can be 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 a discussion 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/milling rates and ultimate dimensions of the parts are provided. The hazardous nature of the etching process 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 provided.

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/monitor anodic thickness/weight of coating 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 commonly employed methods of 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), Ic (sulfuric-boric acid) and IIb (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. Discussions of causes of salt spray failures, European WEEE and RoHS initiatives and available non-chromated conversion coatings are also given.

Chromium Plating for Engineering Applications (Hard Chrome)

The course consists of 10 lessons. Students successfully who complete the exam will be given credit towards the Master Surface Finisher (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher (MSF), this course covers one of the core subject areas for qualifying to obtain MSF certification.

Intended Audience:

This training program is designed to be 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.

Objective:

At the conclusion of this course, attendees should:

- Have knowledge of the basic understanding of basic chemical and electrical principles as they relate to hard chromium plating
- Be able to apply Faraday's law in calculating the amount of time required to obtain a target thickness of chromium plate

Chromium Plating for Engineering Applications

- 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 possible solutions
- Be prepared to take the examination which is part of the Foundation MSF certification program.

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 then 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 then covered.

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 (advantages/disadvantages). 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 provides information on 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 provides information on 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 catalyst 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 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 on 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 to resolve the problem.

Corrosion & Salt Spray

The course consists of 7 lessons. Students successfully completing the exam will be given credit towards the Master Surface Finishers (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher (MSF), this course covers one of the optional subject areas for qualifying to obtain MSF certification.

Intended Audience:

This training program is designed to be beneficial for operators of accelerated corrosion test and supervisors of metal finishing job shop and captive shops that have in-house corrosion testing capability or that farm such testing to outside laboratories. The course is also beneficial to sales personnel serving the metal finishing industry, as it will provide a level of knowledge about the corrosion resistance of various coatings that will allow a better understanding of the needs of their customers.

Goal:

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

Objective:

At the conclusion of this course, attendees should:

- Have knowledge of the basic corrosion mechanisms involved in accelerated corrosion tests
- Be able to understand galvanic corrosion series in sea water and acid rain
- Know the levels of corrosion protection afforded by commonly applied electroplated deposits
- Have knowledge of the equipment used for salt spray and other accelerated corrosion tests, along with bets operating practices
- Know how to properly prepare test specimen for accelerated corrosion test exposure
- Be aware of and have a basic understanding of the differences between the common alternative accelerated corrosion tests such as CASS, Corrodkote, 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

1. **Corrosion Principles, Tests & Design for Corrosion Protection Part 1**
   This lesson begins by identifying the most common mechanisms for the on-set 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 protections is a main focus of this lesson.

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 a discussion of 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 the test results. Special attention is given to monitoring of the chamber conditions and recordkeeping.

5. **Preparing, Exposing & Evaluating Parts**
   This lesson covers the most often mentioned question with 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 they can best train themselves to recognize a certain percentage of surface area that has corroded during the test.

6. **Alternate Accelerated Corrosion Tests**
   This lesson provides basic information on other accelerated corrosion tests such as CASS, Corrodkote, 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 failure of a coating, even when the coating has been properly applied. This is most commonly found on aluminum test panels that have been conversion coated and on sulfuricboric anodized aluminum test panels processed per aerospace specifications. This lesson goes over potential causes of failures that include problems in conducting the test, problems with the test panels and problems on the processing lines. The lesson focuses heavily on operational conditions that might be overlooked—wrong exposure angle, for example.

Electroforming

The course consists of 8 lessons. The informational material on electroforming with nickel was originally produced by Dr. Ron Parkinson of the Nickel Development Institute (NiDI). The course is intended as both an introduction to the electroforming process, but also delves deep enough into the processes to benefit electroformers with a measure of experience as well.

This course is one of the available courses in the Foundation Master Surface Finisher (MSF) certification program.

Intended Audience:

This training program is designed to be 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.

Objective:

The objective of the lessons in this course is to prepare students for a certification examination that will provide them with an opportunity to demonstrate their knowledge in electroforming methods, techniques and processes. At the conclusion of this course, attendees should have a basic understanding of:

- 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

1. **Introduction to Electroforming**
   This lesson introduces the process of electroforming starting with a definition of the process and going through its capabilities and limitations. A comparison of nickel vs. copper is made, and other deposits such as iron, silver and gold are briefly 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, 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. Plating equipment, solution make-up, solution impurities, stress measurement and control and the function of ingredients are the focus of part 1 of this lesson.

4. **Sulfamate Nickel Plating Part 2**
   This is the second part of sulfamate and Watts nickel plating processes as used in electroforming operations. The focus of part two is 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 is also provided.

5. **Mandrels: Types, Materials, Design and Preparation**
   In this lesson, students will be given information on 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 also given.

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. Students successfully completing the exam will be given credit towards the Master Surface Finishers (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher (MSF), this course covers one of the core subject areas for qualifying to obtain MSF certification.

Intended Audience:

This training program is designed to be 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.

Objective:

At the conclusion of this course, attendees should:

- Have knowledge of 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
- Have basic understanding of 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.

Electroplating & Surface Finishing

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-phosphorous, 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 utilized 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.

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

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 will detail the most commonly employed methods 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 will provide 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
(Materials Available in Spanish)

The course consists of 21 lessons. Students successfully completing the exam will be awarded a "CEF" (Certified Electroplater-Finisher) certificate and is a requirement to obtain the Foundation Master Surface Finisher (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher this course covers one of the subject areas for qualifying to obtain MSF certification.

Intended Audience:

This training program is designed to be 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 the needs of their customer.

Electroplating & Surface Finishing

Goal:

The goal of this course is to provide the student with a broad range of information related to fundamentals of electroplating, methods of preparing parts for surface finishing and to understand wide variety of electroplating and other finishing processes.

Objective:

At the conclusion of this course, attendees should:

- Have knowledge of the basic understanding of 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
- Have knowledge of the most common methods of transporting parts through an electroplating process, including barrel, rack, continuous strip/reel-to-reel and vibratory technologies
- Know the 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.

1. **Chemistry**
   This lesson covers the basic chemistry principles that need to be understood in order to better understand the plating process. The lesson begins with the structure of an atom and then builds upon that basic information to yield an understanding of chemical reactions as they may be employed to process parts for plating and for the plating process and post plating processes as well.

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 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 zinc, copper, nickel, and chromium are provided

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.

7. **Hull Cell and Other Test Cells**
   This lesson provides information on the use of the Hull Cell to trouble-shoot 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 upon 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 substrates made of steel, stainless steel, copper, zinc, and aluminum alloys for plating. Covered are ultrasonic cleaning, vapor degreasing, soak cleaning, electrocleaning, descaling and acid pickling. A special focus is given to the zincating of aluminum alloys.

11. **Testing of Plated Deposits**
    This lesson describes the most commonly conducted 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.

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/treatment are discussed for each process. The lesson also covers nickel strike solutions and why/where they would be employed.

16. **Chromium Plating**
    This lesson provides chemical make-up and operational conditions for the decorative chromium plating solutions in use in 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/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/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/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/treatment are discussed.

Environmental Stewardship: Pollution Prevention

The course consists of 10 lessons. Students successfully completing the exam will be given credit towards the Master Surface Finishers (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher (MSF), this course covers one of the optional subject areas for qualifying to obtain MSF certification.

Intended Audience:

This training program is designed to be 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 at pollution abatement suppliers.

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.

Objective:

At the conclusion of this course, attendees should:

- Have knowledge of the basic understanding of 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/recycle 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.

1. Best Operating Practices

This lesson covers the types of operational practices that can have a significant impact on the generation of waste. Topics covered 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, extending the life of cleaners with lipophilic filtration, use of inhibitors in acids, acid substitution, biological cleaners and operational changes that keeps cleaners and acids functioning at peak efficiency.

3. Pollution Prevention and Ion Exchange

This lesson details how ion exchange works and provides guidance as to choice of 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, nano-filtration 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. Students successfully completing the exam will be given credit towards the Master Surface Finishers (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher (MSF), this course covers one of the optional subject areas for qualifying to obtain MSF certification.

Intended Audience:

This training program is designed to be beneficial for operators and supervisors of wastewater pretreatments systems at job shop and captive shops performing metal finishing operations such as electroplating and or anodizing. The 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 or removing, neutralizing and/or destroying a broad range of pollutants found in metal finishing wastewater.

Objective:

At the conclusion of this course, attendees should:

- Have knowledge of 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.

Environmental Stewardship: Wastewater Treatment

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 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 various instrumentation methods of measurement and control employed in wastewater treatment. pH, ORP, 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 a detailed guidance for the most common methods of chemically treating wastes that contain cyanide or chromium (+6). Batch and flow through treatments are discussed. Cyanide treatment via alkaline chlorination is a major focus of this lesson, but 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 will provide information of 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 schemes 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 will detail 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. Students successfully completing the exam will be given credit towards the Master Surface Finishers (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher (MSF), this course covers one of the optional subject areas for qualifying to obtain MSF certification.

Intended Audience:

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

Goal:

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

Objective:

At the conclusion of this course, attendees should:

- 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 features provided by them
- 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.

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.

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 speed a line can operate when multiple layers of plating must be applied. A special focus is made of various techniques that can be 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. A special focus is made on the impact of impurities upon internal stress 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 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. A significant amount of time is devoted to the discussion of colors 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. A significant amount of time is devoted to the discussion of carbonate generation and treatment. Another focus of this lesson is plating gold from the sulfite process.

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.

Plating Essentials

Intended Audience:

This training program is designed to be benefit to individuals who have no experience and no training in the art and science involved in electroplating. Examples of such individuals are new hires for plating line work, inexperienced supervisors, sales personnel serving metal finishers, and those in management that want a non-technical/low technical primer in the subject. This training may also be of benefit as an introductory course for individuals who intend to go on with more advanced training courses.

Goal:

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

Objective:

Initiate the trainee into the electroplating industry by providing only non-technical or low technical information. At the conclusion of this training the student should:

- Have knowledge of the various 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 basic components that make up an electroplating process
- Know the various types of parts and problems that they may pose when processed by electroplating.

1. **Plating Calculations**
   This lesson aims at teaching basic math skills that will 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 will provide 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.

3. **Electroplating Equipment**
   Students are provided with the equipment that makes up a plating line and individual plating tanks and its function. The importance of the proper utilization and maintenance of each of the following equipment is detailed:

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

Zinc - Zinc Alloy Plating

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. Why shields and robbers may be employed 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 specific plating processes that are commonly employed, 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 upon best operating practices when conducting stripping operations.

Zinc - Zinc Alloy Plating

The course consists of 10 lessons. Students successfully completing the exam will be given credit towards the Master Surface Finishers (MSF) certification. While it is not necessary to take any course to be eligible to sit for the respective exam that could lead you to becoming a Master Surface Finisher (MSF), this course covers one of the optional subject areas for qualifying to obtain MSF certification.

Intended Audience:

This training program is designed to be beneficial for operators and supervisors of job shops and captive shops performing zinc and or zinc alloy plating operations on a variety of substrates. The course can also benefit sales personnel at industry suppliers.

Goal:

The goal of this course is to provide students with a broad range of information related to the metallurgy and corrosion behavior of zinc coatings. Students will also know the differences between the various zinc plating processes and between the various zinc alloy plating process, including what can go wrong and how to solve plating problems.

Objective:

The objective of the lessons in this course is to prepare students for a certification examination that will provide them with an opportunity to demonstrate their knowledge in technologies that may be employed in the precious metals plating industry, whereby quality of finished goods may be improved and the costs of operation are reduced or eliminated, making them more valuable to their employer.s At the conclusion of this course, attendees should:

- Have knowledge of the basic behavior of zinc and zinc alloys in retarding the on-set of corrosion of base metals such as steel
- 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 features provided by them
- Know the various type of and zinc alloy plating processes such as 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.

1. **Electroplating Basics for Zinc Platers**
   This lesson will provide 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.

Zinc - Zinc Alloy Plating

2. **Introduction-Historical Development & Applications of Zinc Coatings**
   This lesson will provide an introduction into zinc coatings from a historical perspective that is then followed by a discussion of economics, corrosion mechanisms, and methods used to apply zinc coatings (mechanical plating, electroplating, hot dip galvanizing and flake diffusion processes).

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/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 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/ treatment are discussed.

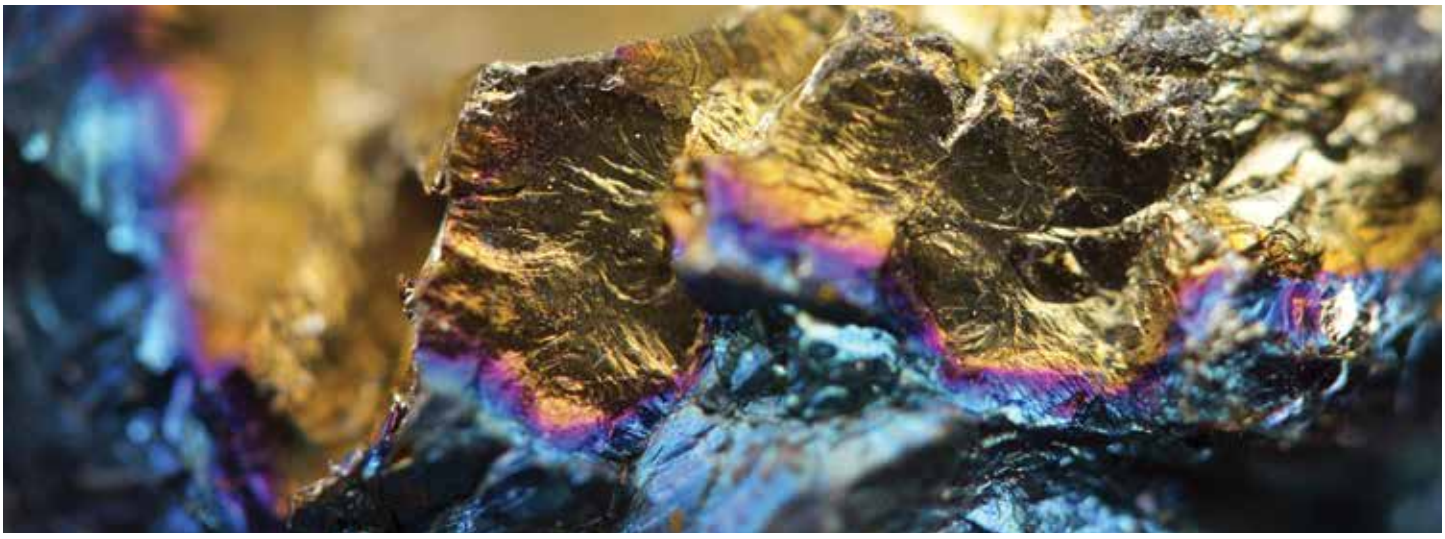
6. **Chloride Zinc Plating**
   This lesson provides chemical make-up and operational conditions for the acid chloride based zinc plating solutions in use in the metal finishing industry. Special focus is given to function of and control over individual ingredients in each process. Common contaminants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

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 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/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/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 yield the highest level of corrosion resistance.



Training Calendar

In-Person Courses	Date(s)	Location	Member	Non-Member
Chromium Plating for Engineering Applications Registration Deadline: March 26	April 9 – 10	Detroit, MI	$760	$910
Optional Exam	April 11		$150	$250
SUR/FIN Electroplating & Surface Finishing Parts 1 & 2 Registration Deadline: March 30	June 4 – 7	Cleveland, OH	**REGISTER FOR BOTH AND SAVE!** $1,400	$1,680
Part 1 Only	June 4 – 5		$760	$910
Part 2 Only	June 6 – 7		$760	$910
Optional CEF Exam	June 8		$150	$250
SUR/FIN Aluminum Finishing Registration Deadline: March 30	June 4 – 5	Cleveland, OH	$760	$910
Optional Exam	June 6		$150	$250

Web-Based Courses	Sessions	Member	Non-Member
Plating Essentials Registration Deadline: January 19	January 30, 31 February 6, 7, 13, 14, 20, 21	$615	$800
Environmental Stewardship Part-1: Wastewater Treatment Registration Deadline: February 20	March 6, 7, 13, 14, 20, 21, 27, 28	$615	$800
Airline & Aerospace Finishing Parts1 &2	August 7, 8, 14, 15, 21, 22, 28, 29 October 2, 3, 9, 10, 16, 17, 23, 24	**REGISTER FOR BOTH AND SAVE!** $1,100	$1,430
Part 1 Only Registration Deadline: July 25	August 7, 8, 14, 15, 21, 22, 28, 29	$615	$800
Part 2 Only Registration Deadline: Sep. 19	October 2, 3, 9, 10, 16, 17, 23, 24	$615	$800
Plating Essentials Registration Deadline: August 20th	September 4, 5, 11, 12, 18, 19, 25, 26	$615	$800
Corrosion & Salt Spray Registration Deadline: October 22	**Six Two-hour Sessions** November 6, 7, 13, 14, 20, 21, 27, 28	$615	$800

Training Calendar

Home-Study Courses	Member	Non-member
Airline & Aerospace Finishing (CAF Course)	$900	$1,125
Airline & Aerospace Finishing (CAF Course – Part 1, Introductory)	$525	$735
Airline & Aerospace Finishing (CAF Course – Part 2, Advanced)	$525	$735
Aluminum Finishing	$525	$735
Chromium Plating for Engineering Applications	$525	$735
Corrosion & Salt Spray	$525	$735
Electroforming	$525	$735
Electroless Deposition	$525	$735
Electroplating & Surface Finishing (CEF Course)	$900	$1,125
Electroplating & Surface Finishing (CEF Course – Part 1, Introductory)	$525	$735
Electroplating & Surface Finishing (CEF Course – Part 2, Advanced)	$525	$735
Industrial & Precious Metals	$525	$735
Plating Essentials	$525	$735
Pollution Prevention	$525	$735
Wastewater Treatment	$525	$735
Zinc and Zinc Alloy Plating	$525	$735

Home-Study Course Shipping	U.S. Address	Non-U.S. Address
CAF/CEF Course	$40.00	$80.00
All Others	$30.00	$60.00

Optional Exams	Member	Non-member
Aluminum Finishing Exam	$150	$250
CAF Exam	$150	$250
CEF Exam	$150	$250
Chrome Exam	$150	$250
Electroless Deposition Exam	$150	$250
Electroforming Exam	$150	$250
Plating Essentials Exam	$150	$250
Precious Metals Exam	$150	$250
Pollution Prevention Exam	$150	$250
Salt Spray Exam	$150	$250
Wastewater Treatment Exam	$150	$250
Zinc Alloy Plating Exam	$150	$250

Registration Policies

Advance Registration is Encouraged

On-site registration, in most cases, is not available. Fee covers materials and coffee breaks. Lunch is usually "on your own." Hotel accommodations are not included.

Cancellations Must Be Made in Writing

In order to receive a refund for any registrations made by phone, fax, mail or web, you must put your cancellation in writing.

16 or more days before start of course or workshops ..... $50 service charge
15 or fewer days before start of course or workshops ..... **No refund**
If you do not attend & do not notify Foundation .....**No refund**
No on-site refunds of registration fees will be made

NASF Members Save Up to 44% off of Registration

Located in Washington DC, NASF represents the interests of businesses, technologists and professionals in the surface coatings industry.

Its highly regarded programs and activities are informed by NASF's mission to:

- **Advance** an environmentally and economically sustainable future for the finishing industry; and
- **Promote** the vital role of surface technology in the global manufacturing value chain.
- **Link** companies, professionals and technical experts together through its events, programs, updates and key committees, and services the total surface finishing sector.

Membership opportunities are available for job shop and "captive" applicators, industrial users, suppliers of chemicals, equipment and services, and technologists and researchers. To become a member of the NASF, please go to www.nasf.org or contact Matthew Martz at mmartz@nasf.org.

If You are Not an NASF Member, Please Pay the Non-Member Rate.

Payment of Registration Fee Conveys Right to Attend Only

NO video taping or recording 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 reasons, the liability of the Foundation is limited to a refund of the registration fee.

To Register:

Email Completed Registration Forms to: mmartz@nasf.org

Fax Completed Registration Forms to: 202.530.0659

Mail Completed Registration Forms to:
NASF Education Foundation
1800 M Street, Suite 400 S
Washington, DC 20036

For More Information Please Contact Matthew Martz:
202.527.0252 | mmartz@nasf.org

Connect with NASF online:

Training Registration

Course Selections:

Course Code	Price	Course Code	Price

☐ **YES!** I have enclosed a completed NASF Application to **Save Up to 44%** Off of My Training Registration

New Member Dues	
Subtotal	
Home-Study Course Shipping (See Chart in Training Calendar)	
TOTAL	

Payment Information:

❑ Enclosed is my check or money order, in U.S. funds, made payable to NASF Education Foundation

❑ Please charge my: ❑ VISA ❑ MasterCard ❑ American Express

Account # _____ Card Expiration Date: _____

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Note: Only full U.S. currency (U.S. bank draft/International money order or credit authorization) will be accepted.

Contact Information:

Name: _____ Job Title: _____

E-Mail: _____ NASF Member # _____

Please supply your home and company addresses. Check the appropriate box where you wish to receive mail.

❑ **Home** Address: _____

City: _____ State: _____ Zip: _____ Telephone: _____

❑ **Company** Name: _____

Company Address: _____

City: _____ State: _____ Zip: _____ Telephone: _____

Education: ❑ High School ❑ College ❑ Degree

Years in the metal finishing field: ❑ Less than 1 year ❑ 1-3 years ❑ > 5 years ❑ > 10 years

Signature: _____ Date: _____

To Register or For More Information: NASF Education Foundation, 1800 M Street, Suite 400 S Washington, DC 20036; Phone: 202.527.0252 | FAX: 202.530.0659 | Prices are current yet subject to change.

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