Welcome,

In this catalog, you’ll find the latest in cutting-edge metalcasting education from the AFS Institute. We now have 40 instructor-led courses that are conducted in Schaumburg, Illinois, or at your facility by highly knowledgeable and experienced metalcasting professionals.

Our courses offer great opportunities for your education and training needs. Whether you are a business owner, a manager, a student, or a professor, this new catalog will help you find the courses you need in one easy-to-access format.

We have many areas of opportunity to help metalcasters run profitable and productive workplaces through the education and training of employees. Investing in our workforce is a critical element of our industry’s future.

For your business to stay competitive, everyone in your organization needs to practice the life-long pursuit of learning. To do that, you will find what you need here:

- 40 instructor-led courses
- 111 e-Learning modules

For more information, please contact AFS Customer Service at 847-824-0181 (800-537-4237 for U.S. and Canada) or visit our website at www.afsinc.org.

Institute Staff Contacts:

Jen Christian  
Director of Training Solutions  
jchristian@afsinc.org

Renee Berrigan  
Education Assistant  
rberrigan@afsinc.org

Table of Contents

Educational Offerings  
Instructor-Led Training.........................03  
In-Plant Training.....................................03  
Regional Training......................................03  
e-Learning Modules.................................04  
Custom On-the-Job Training  
Program Development..............................04  
On-Board Training Schedules......................05

Membership Information  
Corporate Membership...............................06  
Individual Membership.............................07

Courses & Modules  
Instructor-Led Training Courses...................08-21  
e-Learning Modules.................................22-39  
Spanish e-Learning Modules....................40-43
AFS Institute

Educational Offerings

A skilled workforce allows your company to optimize production, minimize errors, and differentiate from the competition.

The premier provider of education for the metalcasting industry is the AFS Institute. Hundreds of foundries, casting purchasers, and suppliers to the metalcasting industry rely on the Institute each year to train and develop their employees. In fact, the Institute has trained more than 89,000 students since 1957.

The Institute offers training in these convenient formats:
- **Instructor-Led Training** in the AFS headquarters in Schaumburg, Illinois.
- **In-Plant Training** customized for the individual company located at the company.
- **Regional Training** in other locales.
- **e-Learning Modules** allowing your workforce to learn anywhere, anytime.

### Instructor-Led Training

The curriculum for all courses is developed to teach new job skills in an interactive, hands-on, student-centered format. We teach our courses in classrooms across the country, with over 35 full-length courses in the following categories:

- Basic Metalcasting
- Casting Sourcing & Costing
- Design of Castings & Gating Systems
- Metallurgy & Melting Methods
- Molding Methods
- Quality Control & Improvement

To learn more about our Instructor-Led Training, visit www.afsinc.org/instructor-led-training.

To see a full list of scheduled upcoming courses or to register for a course, please visit www.afsinc.org/courses.

### In-Plant Training

AFS Institute In-Plant Training provides you with high-value, immediate-impact, best-in-class, unbiased, and professional training at your facility for an affordable price. It is the best way to deliver new skills training to a large group of employees. In-Plant Training provides you with the ultimate in convenience: no travel expenses and a familiar environment while maximizing training efficiency and value.

**In-Plant Training** offers:
- Efficient, cost-effective skills training for a large group
- Hands-on, engaging activities to reinforce skills development
- Team-building opportunities across roles and departments

Special pricing available for AFS Corporate Members.

For more information on In-Plant Training, visit www.afsinc.org/in-plant-training.

To schedule your In-Plant Training, contact Jen Christian at jchristian@afsinc.org.

### Regional Training

Are you an AFS member? A Regional Training course is a great way to bring an AFS Institute course to your location, providing you with the opportunity to fulfill your chapter’s educational mission. Courses are held at an appropriate training facility in your area. In exchange for your active participation in course promotion, your chapter will receive a rebate based on the number of students attending the course from your region.

**Regional Training** brings your chapter:
- Immediate-impact, high-value, unbiased skills training for a large group
- Fulfillment of your chapter’s educational mission
- Training in a convenient location in your region
- Hands-on, engaging activities
- Networking opportunities

For more information on Regional Training, visit www.afsinc.org/regional-training.

To schedule your Regional Training, contact Jen Christian at jchristian@afsinc.org.
Choose what your staff learns, on your timeline. An AFS Institute e-Learning subscription gives your organization unlimited access to all online training modules. Use them for formal staff training or when specific training needs arise. There are over 100 modules, ranging in length from 15 minutes to over an hour, in the following categories, with new modules being added regularly.

- 3D Sand Printing
- Aluminum
- Cast Iron*
- Casting Defect Analysis*
- Coldbox
- Copper
- Gating & Riser Design
- Green Sand Molding*
- Introduction to Metalcasting*
- Lost Foam
- Metalcasting Safety
- Nobake Molding & Coremaking
- Purchasing Castings
- Sand Testing
- Steel

* Available in Spanish

**e-Learning Modules** focus on practical job skills you can use immediately. Each module is based on adult education best practices and strives to engage you throughout. You can purchase e-Learning modules in two ways:

**e-Learning Subscription Program**

Access the full suite of e-Learning Modules for all your employees at one location. The annual subscription fee is based on the number of employees in your facility:

- $1,200 up to 100 employees
- $2,400 up to 250 employees
- $4,800 over 250 employees

**e-Learning Module Individual Access**

e-Learning Modules also are available for individual access for 30 days.

- $50 per module for members
- $100 per module for non-members

To register, visit www.afsinc.org/e-learning. For more information and a FREE self-guided or web demo of the program, contact Renee Berrigan at rberrigan@afsinc.org.

**AFS Institute Custom On-the-Job Training Program Development**

“**You don’t have to be a trainer to develop on-the-job training programs!** Join hundreds of professionals who have discovered how easy it can be to develop training! Just follow our proven methodology and 15 templates and you are on your way to success!”

AFS Custom On-the-Job Training Program Development is designed to teach your employees how to develop on-the-job training programs and build their training skills. Our expert will work alongside your employees to co-develop training programs using our five process methods and 10 on-the-job training methods. We also will provide the needed development resources and templates. After completing the 80-hour program, your employees will be able to develop their own on-the-job training programs.

This development program is often used to support:

- Supervisors
- Superintendents
- Engineers
- Quality professionals
- Safety professionals
- Crew leaders (hourly)

The AFS Custom On-the-Job Training Program Development has been used by companies to develop training for their manufacturing and operations positions. The process is best used by employees who are subject-matter experts. The employee does not need to be a trainer to learn the methods. The program also teaches how to embed AFS e-Learning modules into your on-the-job training programs easily and effectively.

Interested in learning more? Contact Jen Christian at jchristian@afsinc.org.
Do you want to upgrade your on-board training program and improve retention of new hires? AFS Institute e-Learning offers easy to use modules that seamlessly integrate into your current on-boarding program. The Institute has developed full 3-month programs of 40 suggested e-Learning modules providing over 30 hours of training for Aluminum, Copper/Bronze, Iron, and Steel foundries. Below are four samples of on-board training schedules for Aluminum, Copper/Bronze, Iron, and Steel using e-Learning modules. This is a sample of what your program could include.

**AFS Institute On-Board Training Schedules**

Do you want to upgrade your on-board training program and improve retention of new hires? AFS Institute e-Learning offers easy to use modules that seamlessly integrate into your current on-boarding program. The Institute has developed full 3-month programs of 40 suggested e-Learning modules providing over 30 hours of training for Aluminum, Copper/Bronze, Iron, and Steel foundries. Below are four samples of on-board training schedules for Aluminum, Copper/Bronze, Iron, and Steel using e-Learning modules. This is a sample of what your program could include.

**Aluminum On-Board Training Schedule:**
- Aluminum Casting Alloys
- Aluminum Casting Applications
- Aluminum Casting Production
- Big Picture of the Casting Process
- Chemical Binder Handling Safety Requirements
- Coldbox Coremarking Process
- Green Sand Molding Equipment
- Green Sand Molding Process
- Green Sand Raw Materials
- Introduction to Casting Defect Analysis
- Melting and Pouring
- Metalcasting Safety
- Nobake Materials and Equipment
- Permanent Mold Casting Process
- Types of Casting Processes
- Types of Casting Tooling

**Copper/Bronze On-Board Training Schedule:**
- Big Picture of the Casting Process
- Chemical Binder Handling Safety Requirements
- Copper Casting Alloys
- Copper Casting Applications
- Copper Casting Production
- Green Sand Molding Equipment
- Green Sand Molding Process
- Green Sand Raw Materials
- Introduction to Casting Defect Analysis
- Melting and Pouring
- Metalcasting Safety
- Nobake Materials and Equipment
- Permanent Mold Casting Process
- Types of Casting Processes
- Types of Casting Tooling

**Iron On-Board Training Schedule:**
- Basic Melt Practices for Cast Iron
- Big Picture of the Casting Process
- Coldbox Coremarking Process
- Green Sand Molding Equipment
- Green Sand Molding Process
- Green Sand Raw Materials
- Introduction to Cast Iron
- Introduction to Casting Defect Analysis
- Melting and Pouring
- Metalcasting Safety
- Risering Iron Castings
- Six Families of Cast Iron
- Types of Casting Processes
- Types of Casting Tooling

**Steel On-Board Training Schedule:**
- Big Picture of the Casting Process
- Chemical Binder Handling Safety Requirements
- Coldbox Coremarking Process
- Green Sand Molding Equipment
- Green Sand Molding Process
- Green Sand Raw Materials
- Introduction to Steel Heat Treatments
- Introduction to Casting Defect Analysis
- Melting and Pouring
- Metalcasting Safety
- Nobake Materials and Equipment
- Steel Casting Alloys
- Steel Casting Production
- Steel Casting Quality Requirements and Inspection Methods
- Types of Casting Processes
- Types of Casting Tooling

Improve your on-boarding program and get employees trained on technical topics faster with AFS Institute e-Learning.

To register, visit [www.afsinc.org/e-learning](http://www.afsinc.org/e-learning). For more information and a FREE self-guided or web demo of the program contact Renee Berrigan at rberrigan@afsinc.org.
THE AFS CORPORATE MEMBER ADVANTAGE

Business Opportunities & Branding

- **Trade Show/Exhibit Space Discounts** - Save money on exhibits and attendance at CastExpo and Metalcasting Congress (Discounts vary)
- **Sponsorships** - Only Corporate Members are eligible to sponsor for AFS management events
- **Referrals** - AFS refers customer inquiries to Corporate Members
- **Logo** - Corporate members can add credibility to their business by using the AFS logo on brochures and websites
- **Premium Casting Source Directory Promotion** - Receive placement in CSD, used by nearly 25,000 casting buyers and design engineers
- **AFS Shipping Solutions** - Take advantage of shipping savings. (Savings vary)
- **Business Development** - Workforce Development Forum

Government Advocacy

- **Legislative Influence** - On Capitol Hill, AFS shapes a better business climate for metalcasters

Education

- **In-Plant Training** - Corporate Members receive a $2,000-$4,000 discount
- **Classroom Courses** - Receive discounts on classes for new and experienced metalcasters ($200 discount per person)
- **Free AFS Members-Only Webinars** - All employees of Corporate Members participate in technical and management webinars ($250 value per session)
- **E-Learning** - Corporate Members are eligible to subscribe for unlimited access to AFS Institute e-Learning in English and Spanish
- **AFS Library** - Receive free online access to the AFS Library, the world’s largest collection of metalcasting research papers and articles

Industry Intelligence

- **Annual Metalcasting Forecast** - This crucial marketplace outlook is free to Corporate Members ($1,000 value)
- **Wage and Benefit Survey** - Key compensation information, free to participating corporate members ($1,000 value)
- **World Foundry Organization Annual Census** - A look at the state of the worldwide metalcasting industry is delivered free to Corporate Members

Workforce & Career Development

- **Leadership Training & Sustainability** - AFS trains the current and future leaders of metalcasting
- **Building the Next Generation of Metalcasters** - Student chapters, institute training, foundry demonstrations, Melting Point magazine and more to attract new talent to the industry
- **Regional Chapters** - Individual members may join AFS regional chapters
- **Casting Connection** - Members can ask questions and get answers from peers through this metalcasting social network
- **Industry Job Descriptions** - AFS’ complete, detailed list of metalcasting industry job descriptions is available for Corporate Members to use for recruiting, evaluations, or other workforce needs
- **Metalcasting Job Board** - Save 50% when you post jobs on the AFS Job Board
- **Event Discounts** - Save on registration for AFS educational and networking events AFS (Discounts vary)
- **Workforce Development Forum** - Join monthly teleconferences to share best practices

Technical, Management, Research Support, & Innovation

- **Driving Research** - 8% of dues support AFS research, including 40 projects currently underway
- **Committee Membership** - Individual members engage on AFS committees, which sponsor research and help establish industry standards
- **Technical Assistance** - The AFS technical services team is ready for your calls on technical, metallurgical, and EHS questions, and casting design assistance, with top priority going to corporate members
- **HR Consulting** - AFS provides foundry-specific insights and assistance for your human resources needs
- **Energy Consulting** - AFS can help with questions about energy costs, consumption and efficiency

Books & Publications

- **Modern Casting** - A subscription to one of the industry’s leading trade magazines, delivered monthly ($109 value)
- **Casting Source** - A subscription to one of the industry’s leading trade magazines, delivered bi-monthly ($185 value)
- **International Journal of Metalcasting** - A subscription to AFS’ metalcasting research journal ($199 value)
- **Member Connections** - A quarterly print publication featuring industry, AFS and chapter news ($40 value)
- **Book Discounts** - Get 50% off on AFS-published technical books
- **AFS Insider News** - Stay up-to-date on industry news and AFS events with this weekly e-newsletter

For more information, contact Ben Yates at 800-537-4237 or byates@afsinc.org.
Boost Career Success & Professional Development

- **Leadership Training & Sustainability** - Advance your knowledge and learn to lead
- **Build the Next Generation of Metalcasters** - Attract new talent to the industry
- **AFS Regional Chapters** - Build your professional network
- **Casting Connection Metalcasting Social Network** - Find answers and provide solutions with the help of fellow professionals

Maximize Your Technical Knowledge & Career Advancing Networking

- **AFS Institute Courses** - Keep yourself on the cutting edge ($200 discount)
- **Free AFS Members-Only Webinars** - Stay updated on technical and management developments, live or on demand at no cost ($250 value per session)
- **Join an AFS Committee or Chapter and expedite your professional networking** - Shape the direction of metalcasting research and industry standards

Deep Discounts on AFS Events & Publications

- **Conference and Trade Show Discounts** - Save on admission to premier events, including CastExpo and Metalcasting Congress
- **Free Modern Casting Magazine Subscription** - Stay ahead of the curve with the leading metalcasting magazine ($109 value)
- **Book Discounts** - Save 25% on all AFS-published technical books
- **Free Metalcasting Library Access** - Explore the world’s largest collection of metalcasting research
- **Free Member Connections Quarterly Membership Newsletter** - Connect to AFS and learn the latest membership benefits
- **AFS Insider News E-Newsletter** - Stay up-to-date on industry news and AFS events

For more information, contact Ben Yates at 800-537-4237 or byates@afsinc.org.
The following is the full catalog of all courses offered by the AFS Institute. These courses can be taken as Instructor-Led Training, Regional Training, or In-Plant Training.

To see a full list of scheduled upcoming courses or to register for a course, please visit www.afsinc.org/courses.

The pricing listed is for Instructor-Led Training courses. If you want pricing for and/or would like to schedule a Regional Training, or In-Plant Training, contact Jen Christian at jchristian@afsinc.org.
Participants in this introductory course will develop their knowledge of aluminum’s characteristics and properties, the use of appropriate alloying elements, latest industry applications, and important considerations when working with cast aluminum parts. Course materials include the latest information in melting and casting technology and the decision-making process for choosing specific technologies.

Course participants will learn to identify:
• Principal properties of aluminum
• AAUS alloy classification system
• Role of alloying elements in aluminum castings
• Aluminum alloys for specific applications
• Common aluminum melting methods
• Common molding/casting methods for aluminum

**Course Length** — 1 day
**List Price:** $1,000 | **Member Price:** $800

This Institute course covers aluminum furnace and crucible operations, including construction, operations, and maintenance practices for both electric and fuel-fired aluminum crucible furnaces.

Course participants will learn to describe and identify:
• Aluminum crucibles and furnaces
• Maintenance best practices for aluminum crucibles, including storage, handling, cleaning, and safety
• Aluminum furnace refractory materials (linings and crucibles), installation, and how to avoid deterioration
• Proper aluminum crucible furnace operations
• Crucible furnace heating system components and how to optimize performance
• Temperature measurement tools and controls
• The use of energy efficient aluminum crucible furnace optimization methods

**Course Length** — 1 day
**List Price:** $1,100 | **Member Price:** $900

This course introduces the principles and best practices of aluminum melting for metalcasting. The course will examine furnace charging, furnace temperature and its effect on the melt, and in-furnace treatments to reduce impurities. Melt sampling, transfer and pouring methods, and the corresponding equipment will be analyzed, with demonstrations of various techniques throughout the course. Casting defects related to melting, treatment and transfer also will be presented and discussed.

Course participants will learn to describe and identify:
• The principles of transforming solid aluminum to liquid
• Furnace charging procedures
• Accurate temperature measurement and control techniques
• Purposes and methods of alloying
• Impurities and their causes and handling
• Melt loss causes and control methods
• The purpose of fluxing and common methods of melt treatment
• Various sampling and Pouring techniques

**Course Length** — 2 days
**List Price:** $1,350 | **Member Price:** $1,150
This course provides participants with the scientific principles needed to understand the metallurgy of aluminum-based casting alloys. The primary purpose of this course is to facilitate an understanding of the chemical and thermal fundamentals which control structures formed during aluminum solidification.

Course participants will learn to identify:
- Unary and binary phase diagrams to predict the phases (structures) that form during solidification
- Phase diagrams and cooling curves can be used to determine the sources of castability issues
- How solidification impacts casting properties
- The effects of grain refiners and modifiers on microstructures
- How various melt treatments (e.g., degassing, fluxes, and filtration) can impact casting properties
- The types and applications of common melt quality and casting analysis techniques
- How the heat treatment tempers affect microstructure and mechanical properties of cast aluminum alloys

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150

Cost estimating is a critical factor in ensuring a manufacturing company continues to acquire customers and be profitable. Cost estimates are predictions of what the company thinks it will cost to produce a product. This course examines the various cost components and methods used to arrive at an accurate estimate of the production costs. It also provides information on common traps in casting estimates and ways to avoid these traps.

Class participants will learn to:
- Identify key traps in casting cost estimates and how to avoid them
- Assess where an organization may need to reconsider methods for assigning costs
- Classify various costs by work center/department in a metalcasting facility

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150

The intention of this course is for participants to become proficient in applying a 10-step procedure to analyze and reduce metalcasting defects by correctly identifying them and their root causes and determining the appropriate corrective actions. This course is applicable to sand molding processes (green, nobake, coldbox, shell).

Class participants will learn to:
- Name the four most common casting defects, and identify the causes and potential solutions for each
- Apply a 10-step procedure to correctly identify actual casting defects (in samples) and their root causes, and determine appropriate corrective actions and solutions using the AFS-CIATF “International Atlas of Casting Defects” and the three AFS Casting Defects handbooks

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150

This course delves into the major factors that affect final part design. Participants will explore alloy selection, metal-
casting process capabilities and limitations, and their effects on casting design, and the impact of secondary operations. Other major topics will include design for manufacturability, fabrication to casting design conversions, dimensional control, and the importance of casting simulation. Discussion and case studies will be used throughout this two-day course to illustrate effective and practical casting design principles. Participants should have knowledge and experience in designing engineered components prior to attending this course.

Class participants will learn to identify:
- The effect of different alloy characteristics on a finished casting product
- Material property factors to be considered when choosing a casting alloy
- How production and service requirements affect the casting method chosen
- How to choose an appropriate casting process based on the complexity and manufacturability of a part
- The secondary operations that affect casting design
- Factors that control casting tolerance
- The benefits of simulation in casting design

**Course Length - 2 days**
**List Price:** $1,350 | **Member Price:** $1,150

Casting Supplier Auditing

Held at a metalcasting facility, this course will review methods supply chain personnel utilize to effectively perform audits of metalcasting facilities. Participants will spend the better part of the second day auditing several different areas of the foundry as part of this interactive and hands-on course. This course is only open to employees from companies who design and/or purchase metal castings. Class size is limited to 20 participants.

Class participants will learn to:
- Identify major factors affecting casting supplier auditing, including: management, sales, training, production, maintenance, quality checks and shipping
- Perform audits within the metalcasting industry, showing aptitude of processes in both the office and shop floor areas of a casting supplier

**Course Length - 2 days**
**List Price:** $1,450 | **Member Price:** $1,250

Chemically Bonded Sand Testing

This course provides detailed instruction on the need for widely used chemically bonded tests and how to correctly perform them, including proper sand sampling methods from the “AFS Mold & Core Test Handbook.”

Class participants will be able to:
- Explain the purpose of chemically-bonded sand tests
- Describe sampling procedures
- Describe commonly used chemically-bonded sand tests
- Identify test purpose and frequency
- Determine the equipment to be used for each test
- Describe safety considerations for sand binders
- Run chemically-bonded sand tests, independently
- Explain acceptable ranges for chemically-bonded sand test results
- Formulate ways to communicate findings and alternatives

**Course Length – 1 day**
**List Price:** $1,000 | **Member Price:** $800
This course is an introduction to the coldbox coremaking process used in a metalcasting facility. Discussion will include terminology, common sands and binder systems used to make coldbox cores, the coremaking process, using and maintaining equipment, and considerations for identifying core defects.

Class participants will be able to:

- Explain the benefits of using the coldbox process for coremaking
- Explain the coldbox coremaking process and the components of the three most common coldbox systems
- Identify how sand, binder and equipment selection can impact the quality of cores
- Describe the important safety measures and operating practices to use while making coldbox cores
- Identify the key aspects of well-designed tooling
- Identify common coldbox-related casting defects

*Course Length – 1 day*
*List Price: $1,000 | Member Price: $800*

This course is the second course in the coldbox coremaking series and provides the next level of knowledge in relation to the molding process using within a foundry to make coldbox cores. Discussion will cover coldbox terminology; common sands; additives and coatings used; coldbox binders, in particular, phenolic urethane cold box (PUCB) resin; corebox equipment; corebox tooling and best usage parameters; and considerations when troubleshooting and optimizing the process for proper quality assurance.

Class participants will be able to:

- Summarize the coldbox coremaking process
- Compare differences in properties of coldbox binder systems
- Evaluate raw material and equipment options for coldbox coremaking
- Identify the best corebox tooling variation for the catalyst type in use

*Course Length – 2 days*
*List Price: $1,350 | Member Price: $1,150*

This course introduces the characteristics and properties of copper, alloying elements and their general applications, as well as considerations for working with cast copper parts. This course also covers melting and casting technology and looks at the decision-making process behind specific technologies used.

Class participants will learn to:

- Describe the principal properties of copper and its uses
- Explain the Unified Number System for copper
- Discuss the role of alloying elements in copper castings
- Identify copper alloys suited to specific applications
- Identify common melting methods for copper
- Identify common molding/casting methods for copper
- Describe common copper defects
- Discuss foundry safety
- Describe some environmental concerns when handling lead-containing copper alloys

*Course Length – 1 day*
*List Price: $1,000 | Member Price: $800*

This laboratory course introduces the principles and best practices of copper melting and pouring for producing premium quality castings. The various processes involved in melt protection, oxidation, deoxidation and degassing will be examined. Topics include: furnace types and uses,
charge materials, melting practices and tests for melt quality.

Class participants will learn to:
- Describe the advantages/disadvantages of the various furnaces used for copper melting
- Explain the effects of various charge materials on copper melting
- Discuss oxidation-deoxidation and degassing practices for copper melting
- Identify proper Personal Protective Equipment (PPE) used in copper melting and pouring practices
- Describe the tests used for melt quality
- Explain considerations for making quality, high-conductivity copper castings

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150

Knowledge of the physical metallurgy of copper alloys is necessary for foundry metallurgists to effectively operate. This knowledge includes melt treatment, effects of alloy additions on physical and mechanical properties, solidification, heat treatment and final properties. The correlations among the processing technology, defects and properties is important to know for metallurgical as well as environmental issues. This course will address these topics to improve the metallurgical skills of casting personnel.

Class participants will learn to:
- Review influences of alloying elements on mechanical and physical copper properties
- Determine transformation temperatures between liquidus and solidus
- Identify cooling curves and phase diagrams
- Determine phases present in an alloy via an application of binary, ternary and complex phase diagrams
- Identify and explain various solidification characteristics
- Identify and explain several heat treatments of copper castings
- Explain sample preparation procedures as well as cast copper alloy microstructures

• Describe various metallurgical and visual inspection processes
• Identify key casting defects related to copper metallurgy

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150

Design & Optimization for 3D Sand Printing
Categories:

There are many advantages to the use of 3D sand printing of molds and cores, especially when it comes to casting design, and the technology is being rapidly adopted in all sectors. This course focuses on designing castings for the 3D sand printing process, as well as optimizing existing designs to take advantage of the unique capabilities afforded by the process. Course topics include: the advantages/limitations of the 3D printing process, the storage and handling of cores and molds, gating design, and simulation, file formats, and key features allowable will be described. Case studies will be used throughout the course.

Class participants will learn to:
- Describe the various additive manufacturing techniques used in metalcasting
- Describe the 3D sand printing process
- List the process considerations for casting quality
- Describe cost implications of the process and their advantages/disadvantages
- Identify the optimal type of parts for the process
- List the design considerations for casting quality
- Identify methods to improve designs
- Describe the role of casting process simulation

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150
### Ergonomics Workshop

**Categories:**
- 🗝️
- 🔍

This course covers the use of ergonomic principles to recognize, evaluate, and control workplace conditions that cause or contribute to employee safety and productivity issues. Topics include the definition and three components of ergonomics; work physiology; anthropometry; musculoskeletal disorders; common risk factors such as vibration, temperature, material handling, repetition, and lifting; computer workstations; elements of an ergonomic program; and developing the business case for ergonomic improvements. Course emphasis is on office and foundry “shop floor” examples, covering analysis and design of equipment workstations and workflow.

**Class participants will learn to:**
- Define ergonomics and its three major components
- Outline the components of an ergonomics program
- Describe the components of office and shop floor ergonomic evaluations
- List the common risk factors and areas for ergonomic improvement within foundries
- Describe how to evaluate, select and implement ergonomic solutions
- Describe the essential elements for an effective ergonomics business case

**Course Length - 1 day**

**List Price:** $1,100 | **Member Price:** $900

### Foundry Process Improvement

**Categories:**
- 🔴
- 🌌

Participants will receive basic root cause analysis training, which can serve as a refresher, a preparatory course for the American Society for Quality (ASQ) Six Sigma Green Belt Certification program, or as a follow-up to any quality certification training. Metalcasting facilities often struggle with problem solving and have a need for training with a focus on metalcasting issues. At its core, this course provides personnel with disciplined problem-solving techniques, and emphasizes tools to better understand process data and performance using unique examples and case studies drawn from metalcasting facility settings.

**Class participants will learn to:**
- Identify how casting quality requirements impact gating and risers
- Describe the function of risers
- Identify the effects of different alloys on riser size and location
- Identify the effects of production process parameters on riser size and location
- Determine riser locations
- Calculate the size of riser and connections
- Demonstrate the basic applications of chills
- List unique riser considerations for iron castings
- Describe the function and features of a gating system

**Gating & Riser Design 101**

**Categories:**
- 🏛️
- 🪵

Gating design directly impacts casting quality and yield. This course guides participants through the basic functions of gating and risers to provide clean, sound, and functional castings. An introduction to fluid flow and solidification will serve to guide participants through key design concepts of the various functional elements of good gating and riser design. Emphasis will be placed on hands-on activities, animations, and simulations to enhance understanding of the filling and solidification processes in a foundry. The focus will be on practical examples in iron, steel, aluminum, and copper castings. The goal will be to introduce to the participants the basics of gating and riser design, common industry norms and troubleshooting.

**Class participants will learn to:**
- Describe structured problem-solving approaches
- Develop effective problem statements
- Characterize problems to develop possible root causes
- Recognize various methods for collecting and analyzing data
- Explain why process stability is required for improvement
- Identify process sampling strategies for determining root cause
- Determine process improvement solutions and countermeasures
- Implement corrective action to sustain improvement

**Course Length - 2 days**

**List Price:** $1,350 | **Member Price:** $1,150
• Identify the effects of different alloys on a gating system
• Identify the effects of process parameters on gating system design
• Determine gate sizes and locations
• Describe the basics of fluid dynamic principles

Course Length – 2 days
List Price: $1,250 | Member Price: $1,050

Gating & Riser Design 201
Categories:

This course is a continuation of the concepts introduced in Gating & Riser Design 101. Participants will work on case studies to develop gating and risers to provide clean, sound, and functional castings. A continuation of the fluid flow and solidification principles will serve to guide participants to decision making regarding the quality of castings. Course emphasis will be placed on hands-on activities, animations, and simulations to enhance understanding of the filling and solidification processes in a foundry. Focus will be on practical examples in iron, steel, aluminum, and copper castings. The goal will be to introduce the participants to the basics of gating and riser design, common industry norms and troubleshooting.

Class participants will learn to:
• Describe the use of sleeves, hot topping, specialty sands and the cost vs. benefit of each
• Describe sand and chill properties
• Measure the influence of sand and chill properties on cooling conditions to positively impact casting quality
• Describe fluid flow principles governing the flow of liquid metal
• Measure how flow principles governing the flow of liquid metal positively affect casting quality
• Identify the use of filters and other hydraulic controls
• Describe the influence of process parameter ranges with a fixed tool design on the casting cost and quality
• Identify how to accommodate for variations in process parameters while maintaining casting quality
• Translate quality requirements to cost implications for castings
• Develop a closed-loop tooling performance feedback system.

Course Length – 2 days
List Price: $1,350 | Member Price: $1,150

Green Sand Molding 101
Categories:

Students are introduced to the green sand molding process used with a metalcasting facility. Discussion will include: basic terminology, types of sands used to make green sand molds, the mold making-process, using and maintaining process equipment, and considerations for identifying casting defects.

Class participants will learn to:
• Use the various types of green sand molding raw materials and equipment appropriately and safely
• Identify raw material and equipment problems and their effect on process variables
• Prepare simple green sand molds and discuss how to meet quality specifications
• Examine molds and castings for defects and determine the corrective action needed
• Describe the important safety measures and operating practices during the production of green sand molds

Course Length - 1 day
List Price: $1,000 | Member Price: $800

Green Sand Molding 201
Categories:

The first day of this course includes a review of important raw material requirements for green sand systems, an introduction to applications requiring specialty sands, the types of sand additives and their effects on green sand and green sand process variables and method adjustments to produce quality molds. The second day will focus on green sand quality control tests for ferrous and nonferrous alloys, typical problem areas seen in green sand metalcasting facilities, and how test results can help to identify areas for correction. The course will conclude with an introduction to statistical process control for sand systems.

Class participants will learn to:
• Summarize the typical green sand systems used for various alloys
• Identify applications requiring specialty sands
• Describe common sand additives used by green sand metalcasters
AFS Institute

Instructor-Led Training

- Identify sand handling and reclamation equipment and processes
- Examine green sand process variables and learn to make process adjustments
- Explain the various quality control tests used in green sand foundries
- Use quality test data to evaluate green sand for corrective action
- Recognize common quality control problems
- Describe important safety measures and operating practices to use in green sand foundries

**Course Length - 2 days**
*List Price: $1,350 | Member Price: $1,150*

---

**Green Sand Testing**

This course provides detailed instruction on how to perform the commonly used green sand tests, including proper sand sampling methods, from the AFS Mold & Core Test Handbook.

Class participants will learn to:
- Describe green sand tests and sampling procedures
- Identify green sand test frequency and purpose
- Determine proper test equipment
- Adhere to safety requirements
- Run green sand tests independently
- Determine and discuss acceptable green sand testing ranges

**Course Length - 1 day**
*List Price: $1,000 | Member Price: $800*

---

**Identifying the Correct Casting Defect**

Participants will be introduced to a basic overview of a casting defect analysis procedure. Course topics will include an introduction to the 10-step method for casting defect identification, how to compose a problem statement, a discussion on the importance of recording process parameters, an introduction to navigating the “International Atlas of Casting Defects”, a path to identifying the correct defect and its root cause for corrective action. Learning a systematic procedure for root cause identification supports the business goal of designing, producing, and selling quality castings in a timely manner in a safe environment at a profit.

Class participants will learn to:
- List the steps used in casting defect analysis
- State the benefits of using a consistent approach
- Identify a good problem statement
- Collect process data using the process sheet
- State the importance of evaluating data
- Use the international atlas of casting defects classification system

**Course Length - 0.5 days**
*List Price: $500 | Member Price: $425*

---

**Introduction to Casting Alloys**

A comparison of the commonly cast ferrous and nonferrous alloys will be presented. There will be discussions on casting applications, properties, and criteria for selection of the following alloys: iron, steel, copper aluminum, magnesium, zinc, and super alloys.

Class participants will learn to:
- Explain reasons for using the different alloy types
- Describe the difference between ferrous and nonferrous alloys
- List at least three criteria that must be considered during alloy selection
- Explain the alloy classification system and list some common alloys, their mechanical and physical properties; and applications/industries

**Course Length – 0.5 days**
*List Price: $500 | Member Price: $425*
Introduction to Coreless Induction Furnace Operation

This course provides participants with best practices for safe operating techniques for induction melting. Topics include furnace components, the sequence of operations for daily start-up, “normal” furnace operation and types of induction furnaces, the differences in induction furnaces sizes; emergency situations and action plans.

Class participants will learn to:
- Identify furnace components
- List the sequence of operations for daily start-up
- Describe a normal furnace operation
- Describe safe operating techniques of induction melting
- List the types of induction furnaces
- Identify an emergency and determine an action plan
- List the daily maintenance tasks for induction furnace operations

Course Length - 1 day
List Price: $1,000 | Member Price: $800

Iron 101

This is an introductory course covering the major cast iron families. Course topics include: characteristics and properties as well as general applications for each iron type; common alloying elements and their uses; iron melting technology and considerations; compatible casting processes and heat treatment options; and applications.

Class participants will learn to:
- Describe the critical factors and features of cast iron that make it the casting alloy of choice
- Understand how elements in cast iron are adjusted to produce different grades
- Explain the classification systems for each of the five cast iron families
- Discuss the mechanical and physical properties of each of the five families of cast irons
- State four important inspection/testing methods for determining cast iron quality
- Analyze how different elements impact the properties of cast iron
- Describe the basic melting practices and related technologies for cast iron
- Compare iron casting processes
- Explain the use of heat treatment of cast iron and how it affects mechanical properties and cost
- Apply safety procedures to the daily work environment in a metalcasting facility

Course Length - 1 day
List Price: $1,000 | Member Price: $800
Iron Metallurgy 201

This course will provide participants with the knowledge and skills regarding the terminology, principles, and techniques for the metallurgy of gray and ductile iron casting alloys. Topics include equilibrium phase diagrams, kinetics (rates of change), eutectic solidification, undercooling, graphite shapes in gray and ductile iron, effects of alloying elements, eutectoid reaction in cast irons, mechanical testing, and defects related to metallurgy.

Class participants will learn to:

- Recognize and describe the fundamentals of the Fe-C/Fe₃C equilibrium (phase) diagram and the effect of adding silicon
- Describe the concepts of equilibrium and kinetics (speed of reactions)
- Identify and explain the solidification (eutectic) reactions that produce graphite and Fe₃C
- Describe the solidification behavior of ductile iron vs. gray iron vs. white iron
- Describe the process for pearlite formation in graphitic cast irons
- Relate solidification behavior to key points on cooling curves for various irons
- Describe the analysis of metallographic samples for cast irons, including phase identification
- Describe the major types and applicability of mechanical testing methods for irons
- Recognize metallurgical defects in gray and ductile iron

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150

Metalcasting Process Basics

This course provides participants with a basic overview of the metalcasting process. It will track the path of a casting from quoting through shipping. This course covers common metalcasting terms and highlights the activities inside the major departments of a metalcasting production facility.

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150
Class participants will learn to:
• Define key industry terms
• Describe the major departments in a metalcasting facility
• Chronologically track a casting through the metalcasting facility from quoting to shipping

Course Length – 0.5 day
List Price: $500 | Member Price: $425

Nobake Molding & Coremaking 101
Categories: 

This course provides participants with a foundation of the nobake molding and coremaking process used within a foundry and is designed for those with little or no prior experience in making nobake molds. Course discussion will include: basic terminology; common chemical binders used; the mold and coremaking process; equipment; and mold defect analysis.

Class participants will learn to:
• Identify the important safety measures and operating practices to use while making nobake molds and cores
• Recognize the various types of raw materials and equipment used during the mold and coremaking process
• Prepare nobake molds and cores that meet quality specifications
• Examine molds and cores for defects and determine the appropriate corrective action

Course Length – 1 day
List Price: $1,000 | Member Price: $800

Nobake Molding & Coremaking 201
Categories: 

This course includes advanced foundry terminology, introduction to specialty sands, sand variables and sand additives, as well as an in-depth discussion of the types of chemical binders used to make nobake molds and cores. There will be added focus on the mold and coremaking processes, how to use more complex tools and components, the use of refractory coatings, adhesives, how to evaluate problem areas with raw materials, binders, and equipment, how to adjust the process to ensure a quality mold, discussions on quality control tools and checks.

Class participants will learn to:
• Summarize the advantage/disadvantages of various types of sand used in the nobake process
• Identify the equipment and processes used to handle and reclaim sand
• Describe common equipment challenges present in the nobake molding process
• Describe the basic sand additives, refractory coatings, adhesives, and release agents used in the nobake process
• Compare the variables of common sand binder systems
• Recognize ways to determine the best sand and binder for the mold application
• Follow the process for using mold-making tools and components
• Recognize raw material and equipment issues and their effect on process variables
• Use quality control check data to evaluate molds for defects and determine corrective action

Course Length – 2 days
List Price: $1,350 | Member Price: $1,150

Permanent Mold Thermal Management
Categories: 

Permanent mold casting is a significant and major process used in the metalcasting industry. This course provides essential information on key factors that affect the thermal profile in a permanent mold casting process cycle. The most common permanent mold manufacturing practices for mold thermal management that focus on ensuring product quality will be covered.

Class participants will learn to:
• Identify the types and properties of mold materials along with factors used in the selection and design of permanent molds for thermal control
• Explain the permanent mold process and machine safety measures
• Identify various cooling, heating, and other methods of controlling permanent mold temperatures
• Explain the importance of documenting the permanent mold process
• Recognize and troubleshoot various defects of permanent mold castings

Course Length – 1 day
List Price: $1,100 | Member Price: $900
Steel 101

This introductory course provides participants with a basic understanding of steel classifications, metallurgical aspects, and the steelmaking process. This course covers the following topics: steelmaking and casting in a metalcasting facility, metallurgy and classification, heat treatment, quality control and understanding customer steel specifications.

Class participants will learn to:
• Describe the main principles and features of the steelmaking, molding and metalcasting processes
• Explain the chief properties and types of steel, as well as what distinguishes it from iron:
• Describe the various heat treatment processes and procedures
• Describe inspection methods along with types and causes of steel defects
• Identify industry requirements and standards for inspections and welding repairs
• Describe features of chemical and mechanical testing of steel
• Explain the importance of fully understanding customer specifications and the role of communications in the specification process

Course Length - 1 day
List Price: $1,000 | Member Price: $800

Steel Melting 201

This course will study the operations of steel melting furnaces including electric arc and induction, the process steps during charging and startup, melt down, chemistry slag control, alloying, tapping, and process documentation, post melt processing methods, Argon Oxygen Decarburization (AOD) and Vacuum Oxygen Decarburization (VOD), melt quality control of undesirable elements with sampling and chemistry measurements, ladle selection and considerations, including maintenance and safety procedures.

Class participants will learn to:
• Explain the difference among steel melting processes
• List melt-stock components
• Explain alloying techniques

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150

Advanced 3D Manufacturing

This 2-day course will cover basic casting design rules comparing the traditional sand casting with toolingless 3D sand printing and emphasize the design freedom that comes with it. Overall design and optimization process and computer aided engineering tools including the effective use of casting process simulation for any new product development, casting conversion and redesign for thin-wall lower weight cast components will be covered with case studies. Key aspects of surface finish and dimensional tolerances with this new sand casting process will be discussed along with the typical casting and mold defects with examples. Overall inspection and quality control aspects for the 3D sand printing will be highlighted.

Class participants will learn to:
• Identify basic casting design rules
• Describe the differences between the 3D sand printing and traditional casting processes
• Identify casting design optimization methods and computer aided design tools
• Identify dimensional tolerances, compare traditional and 3D sand printing tolerances and surface finish
• Identify common potential casting and mold defects in the 3D sand printing process
• Identify root causes for casting and mold defects
• Describe inspection methods and quality control tests for mold and casting production

Course Length - 2 days
List Price: $1,350 | Member Price: $1,150
Human visual inspection is the most common method to confirm the quality of work, whether in manufacturing or service industries. Yet it is very common to assume not much can be done about the generally low reliability of visual inspection – to err is human!

For people interested in improving visual inspection practice, few resources have been available – until now. The course “Improving the Effectiveness of Visual Inspection” provides you with the information needed to understand the factors of influence on the human task of visual inspection, permitting true quality engineering of this critical operation. The course is based on Ted Schorn’s 2018 book of the same name (provided with the course) that summarizes the research into visual inspection through hands-on learning and interaction with the author.

**Course Length - 2 days**  
**List Price:** $1,250 | **Member Price:** $1,050

---

The purpose of this one-day course is to provide operations and training leaders with tools and templates to support training efforts at their facilities. This course will provide a strategic view of industrial training with specific applications based on your company's situation. This highly interactive workshop will ask participants to share their experience and insights. This course will focus discussions around training strategies and solutions specifically for operations and maintenance employees.

**Course Length - 1 day**  
**List Price:** $1,000 | **Member Price:** $800

---

This course will diagnose the current impacts on retention, identify opportunities for improvement, and define a strategic plan to move forward. The course is intended to provide a breakthrough for the strategic and tactical efforts to improve retention by following a simple six-step process.

**Course Length - 0.5 day**  
**List Price:** $400 | **Member Price:** $300
AFS Institute

e-Learning

The following is the full catalog of all e-Learning Modules offered by the AFS Institute. e-Learning Modules can be purchased via the Subscription Program or on an individual access basis. See page 5 or visit www.afsinc.org/e-learning for more details or to register for e-Learning Modules.

For more information and a FREE self-guided tour or web demo of the program, contact Renee Berrigan at rberrigan@afsinc.org.
This e-learning module will compare the 3D sand printing process with the traditional sand casting process and identify the advantages of additive manufacturing, including cost and time implications. The module incorporates optimized real-world applications of 3D sand printing. Upon completion of this module, you will be able to apply where 3D sand printing addresses complexity, speed to solution/prototype, and cost vs. castability.

This e-learning module will define and identify the different types of additive manufacturing (AM). The 3D sand printing process and the basic means of creating a 3D sand printed mold will also be explained. The module will assist you in identifying the different types of 3D sand printing materials. Upon completion of this module, you will be able to identify the process, terminology, and applications regarding 3D sand printing.

In this module, the AFS 1114-00-S: Acid Demand Value (ADV) sand test will be demonstrated. Module topics will include: purpose of the ADV test, basic variables that factor into the test, and performing the test in a virtual environment. By the end of this module, you will be capable of measuring the Acid Demand Value of sand.

The AFS 5211-04-S: Clay, AFS Method test will be the focus of this module. Topics that will be covered: test objectives, basic test variables, and performing the test in a virtual environment. By the end of this module, you will be able to determine the percentage of clay (and other particles that settle at a rate of less than one inch per minute in water, typically material <20 microns).

The AFS 5224-13-S: Permeability, Standard AFS 2 in. Dia. x 2 in. Test Specimen test will be the focus of this e-learning module. Prior to performing this test, you must complete the following sand tests: AFS 5222-13-S: 2 in. Diameter x 2 in. Specimen Preparation, Rammer Method and AFS 2251-00-S: Riddling, Molding Sand. These tests are incorporated in this module. Module topics that will be covered: purpose of the test, basic test variables, and performing the test in a virtual environment. By the end of this module, you will be able to determine the permeability of a Standard AFS (2 in. Dia. x 2 in.) test specimen.
In this module, the various mechanical and physical properties of aluminum that make it the casting alloy of choice will be defined. The Aluminum Association alloy designation system will be explained to identify the various alloying elements of aluminum. In addition, an introduction to aluminum heat treatment operations will be presented. By the end of this module, you will be able to describe the principal properties of aluminum; classify an aluminum alloy using the Aluminum Association designation system, identify the different alloying elements of aluminum; and define the various aluminum heat treatment operations.

In this module, learn about the problems associated with aluminum oxide and inclusion defects and their classification. Explore oxide and inclusion measurement and removal methods, and also learn about methods to avoid inclusions. By the end of this module, you will be able to describe problems associated with aluminum oxide and inclusion defects, determine whether an inclusion is oxide related or otherwise, identify measures to be taken to remove oxides and inclusions, and identify methods to avoid oxides and inclusions.

This module will identify the properties that should be considered in the selection of an aluminum alloy and briefly review the aluminum alloy family characteristics that make them suitable for general casting applications. This module will conclude by choosing an aluminum alloy suitable for a case study. By the end of this module, you will be able to identify aluminum alloys suited to specific applications.

This module will explore the aluminum casting production process. Four furnace types and five major types of casting processes for aluminum will be examined. Some safety considerations will also be included. By the end of this module, you will be able to identify the common melting techniques and molding methods for aluminum.

Different cast iron melting and pouring procedures will be explained along with quality tests (pre- and post-casting); cooling rates; and the three types of melt treatments used in metalcasting facilities. By the end of this module, you will be able to identify four important inspection/testing methods for determining cast iron quality and describe the basic melting practices and related technologies for cast iron.

*Also available in Spanish.
In this module, the various mechanical and physical processes that affect solidification shrinkage in gray iron will be discussed. Topics that will be covered include: the differences between pure iron and graphitic cast irons; the unique characteristics of gray irons; the range of behavior for gray irons over the normal range of carbon equivalent (C.E.); the effects of solidification shrinkage on casting quality and defect appearances; and some steps and considerations to reduce the risk of solidification shrinkage defects. By the end of this module, you will be able to identify two control measures to reducing solidification shrinkage in gray cast irons.

*Also available in Spanish.*
This module will focus on how to choose an appropriate casting process based on the complexity and manufacturability of a part. Topics will include defining the various casting processes available, tolerances, and the opportunity to complete a challenge. This module is designed for those who are involved in selecting, designing, and creating various types of molds and castings. By the end of this module, you will be able to choose a suitable casting process based on the complexity and manufacturability of a part.

By the end of this module, you'll be able to identify the 10-Step Procedure and use these steps to analyze a casting defect.

*Also available in Spanish.*

This module will cover the following topics: heat flow and cooling rates, mold materials and methods, voids, irregularities, and post casting treatments. These topics affect the final mechanical properties of a casting. By the end of this module, you will be able to identify and describe a variety of production characteristics that can influence the mechanical properties of a casting.

This module will identify the various types of personal protective equipment (PPE), safe handling practices, and equipment maintenance regarding chemically bonded sand testing. Chemically bonded sand testing, in this module, consists of nobake and coldbox mold and coremaking processes. By the end of this module, you will be able to identify the important safety guidelines to use during the production of chemically bonded molds and cores.

This module will identify how sand can impact core and mold making production costs and casting quality. There will be emphasis on controlling the temperature and moisture of your system. The various properties for binder selection and the consequences of poor performance for each property will be identified. This module will conclude with identifying core and casting defects and their causes. By the end of this module, you will be able to identify how sand and binder selection can impact the quality of cores and determine causes for core and casting defects.
The top three coldbox systems will be identified in this module. The different types of foundry sands and how they impact coldbox molds and cores will be explored. By the end of this module, you will be able to explain the components of the top three coldbox systems.

Coldbox Coremaking Process

In this module, the coldbox coremaking process, related terminology, and the benefits/factors to using the coldbox process will be identified. By the end of this module, you will be able to explain the coldbox coremaking process.

Coldbox Tooling Design Basics

In this module, the key aspects of well-designed tooling will be identified and applied to a case study. The types of core boxes, blow tubes, ejector pins, parting seals, and vents will be identified. By the end of this module, you will be able to identify the key aspects of well-designed tooling.

Compaction

In this module, the AFS 2220-00-S: Compactability of Molding Sand Mixtures, Rammer Method sand test will be performed. By the end of this module, you will be able to determine the percentage decrease in the height of a loose mass of sand under the influence of compaction.
**Copper Casting Defects: Gating**

This module focuses on gating-specific defects that occur in copper castings. This module will also define what is a gating system and common terms related to gating. Basic principles of solidification and shrinkage are also discussed. By the end of this module, you will be able to review the 10-Step Procedure used to analyze casting defects, identify copper casting gating defects, and identify gating changes that can reduce these defects.

**Copper Casting Defects: Shrinkage**

In this module, shrinkage porosity will be defined and various shrinkage porosity characteristics and classifications will be identified (e.g., size, distribution, location, and performance). By the end of this module, you will be able to define macro and micro porosity shrinkage copper casting defects and identify two control methods to reduce those defects.

**Copper Casting Production**

This module will explore the different melting and molding methods used in copper metalcasting facilities. Copper safety practices will also be presented. By the end of this module, you will be able to identify common melting methods and identify common molding methods for copper alloys.

**Elements in Cast Iron**

In this module, the role of carbon, silicon, and alloying elements in cast iron will be explored. This module will conclude with two real world case studies that compare different cast iron grades. By the end of this module, you will be able to analyze how different elements affect the properties of cast iron.

*Also available in Spanish.*

**Friability**

The AFS 2248-11-S: Friability sand test will be taught in this module. In addition, the AFS 2251-00-S: Riddling, Molding Sand and AFS 5222-13-S: AFS 2 in. Dia. x 2 in. Specimen Preparation, Rammer Method tests are part of the Friability test and included in this module. Module topics will include: purpose of the tests, basic variables that factor into the tests, and performing the tests in a virtual environment. By the end of this module, you will be able to measure the resistance to surface abrasion of green molding sands.
Riser function, riser types and their features, gating system functions and features, and riser sleeves and chills will be explored. This module also covers basic riser and gating system terminology. By the end of this module, you will be able to describe the functions of risers; list the types of risers and their features; describe the function and features of a gating system; and describe the use of sleeves and chills.

In this module, the many sources of gas-related defects and the three types of gas-related defects will be identified. This module will also identify the causes of these three types of defects and control measures that can be made at your facility. By the end of this module, you will be able to list the three types of gas-related defects and two control measures for each gas-related defect.

In this module, the different types of sand compaction will be explored. This module will also explain methods to prevent and resolve sand compaction problems. By the end of the module, you will be able to list the four methods to compact sand to ensure optimum quality castings.

In this module, the mulling sequence of horizontal wheel mullers will be explored and the primary tests involved in basic process control will be discussed. This module will also explore green sand strengths and the different alloy requirements. By the end of the module, you will be able to analyze raw material issues that may affect the quality of green sand molding outcomes.

The five key pieces of molding equipment needed to make a quality green sand mold will be identified along with proper equipment maintenance techniques. This module also consists of an optional safety section concerning personal protective equipment (PPE) and molding equipment. By the end of the module, you will be able to describe the measures required to choose, use, and maintain green sand molding equipment.

In this module, the many sources of gas-related defects and the three types of gas-related defects will be identified. This module will also identify the causes of these three types of defects and control measures that can be made at your facility. By the end of this module, you will be able to list the three types of gas-related defects and two control measures for each gas-related defect.

*Also available in Spanish.

*Also available in Spanish.

*Also available in Spanish.

*Also available in Spanish.
<table>
<thead>
<tr>
<th>Module</th>
<th>Title</th>
<th>Categories</th>
<th>Description</th>
<th>Availability</th>
</tr>
</thead>
<tbody>
<tr>
<td>e51</td>
<td>Green Sand Raw Materials</td>
<td><img src="gs.png" alt="icon" /></td>
<td>This module will identify the different types of sand, clay, and additives that are used in making green sand molds. The features and properties that affect compactability and the role of water in green sand molding will be discussed. By the end of the module, you will be able to identify and assess the raw materials used in creating high-quality green sand molds.</td>
<td><em>Also available in Spanish.</em></td>
</tr>
<tr>
<td>e55</td>
<td>Introduction to Cast Iron Heat Treatments</td>
<td><img src="icfe.png" alt="icon" /></td>
<td>In this module, the reasons why cast iron metalcasting facilities heat treat their castings will be examined. We will also define the various heating and cooling cycles available. By the end of this module, you will be able to explain the use of heat treatment in cast iron and how it affects mechanical properties and cost.</td>
<td><em>Also available in Spanish.</em></td>
</tr>
<tr>
<td>e53</td>
<td>Introduction to Cast Iron</td>
<td><img src="icfe.png" alt="icon" /></td>
<td>This module will identify the industries that use cast iron, the alloying elements used in the production of cast iron, and the mechanical and physical properties of cast iron. By the end of the module, you will be able to describe the critical factors and features of cast iron that make it the casting alloy of choice.</td>
<td><em>Also available in Spanish.</em></td>
</tr>
<tr>
<td>e57</td>
<td>Introduction to Cast Iron Melting</td>
<td><img src="icfe.png" alt="icon" /></td>
<td>This module will provide a brief overview of the cast iron melting process and the multiple furnace types used in cast iron melting. In addition, general safety practices to perform while working on the shop floor and when visiting a metalcasting facility will be defined. By the end of this module, you will be able to briefly explain the cast iron metalcasting process and apply safety procedures in your daily work environment.</td>
<td><em>Also available in Spanish.</em></td>
</tr>
<tr>
<td>e59</td>
<td>Introduction to Cast Iron Microstructures</td>
<td><img src="icfe.png" alt="icon" /></td>
<td>This module will identify the differences between unary, binary, and ternary phase diagrams; define the microstructural components in the cast iron phase diagram and explain how and why microstructures form. By the end of this module, you will be able to identify unary, binary, and ternary phase diagrams.</td>
<td><em>Also available in Spanish.</em></td>
</tr>
</tbody>
</table>
This module is divided into three parts:

• Part 1: Meet Metro Metalcasting, Inc.
• Part 2: Categorize Casting Defects
• Part 3: Analyze Casting Defects

Part 1 of this module will be an introduction to Metro Metalcasting, Inc. (a fictional company) that is experiencing a high percentage of casting defects. Through the solutions team, participants will be introduced to a systematic approach to analyzing and reducing casting defects, the 10-Step Procedure. In Part 2, the seven categories of casting defects will be described and participants will become familiar with the "International Atlas of Casting Defects." In Part 3, participants will learn how to use the 10-Step Procedure to resolve a casting defect. You will be introduced to the tools used in each of the 10 steps and how to implement them. By the end of this module, you will be able to identify the 10-Step Procedure and use these steps to analyze a casting defect.

*Also available in Spanish.

In this module, the visual inspection and physical properties needed to look at green sand defects will be identified. This module will also describe the causes of common green sand defects. By the end of the module, you will be able to identify one shrinkage defect, one gas porosity defect, one sand adherence defect, one sand strength defect, and one sand expansion defect.

*Also available in Spanish.

This module provides participants with an overview of lean manufacturing and how to avoid the seven primary sources of waste. By the end of this module, you will be able to describe lean manufacturing concepts and process measurements that drive improvements in productivity and reduce costs and identify the seven primary sources of waste and how to avoid them.

In this module, steel heat treatments will be defined and the basic steps to heat treating steel will be identified. The following heat treatment techniques will be introduced: annealing, normalizing, quenching, tempering, austempering, precipitation hardening, solution treating, and stress relieving. By the end of this module, you will be able to describe the various heat treatment processes and procedures for steel.

This module reviews the basics of lean manufacturing, sensors, and the Industrial Internet of Things. From these concepts, you will apply what you have learned to your own lean manufacturing opportunity and complete the Lean Manufacturing Opportunity form. By the end of this module, you will be able to identify opportunities to improve your facility using lean manufacturing principles and document opportunities for improvement.
This module provides participants with the opportunity to work through some real case studies to enable thinking about how to apply lean manufacturing concepts. By the end of this module, you will be able to understand how to apply lean manufacturing concepts to real-life foundry problems and begin to think about how you can apply these concepts to the foundry where you work.

This module discusses the following topics: Industrial Internet of Things (IIoT), sensors, measurements, and metrics. By the end of this module, you will be able to describe the Industrial Internet of Things and how it fits in with lean manufacturing concepts and identify sensors and methods of utilizing the Industrial Internet of Things.

The basics of the lost foam process will be discussed in this module. Terminology, the casting process, and properties of the lost foam casting process will be addressed. By the end of this module, you will be able to define key lost foam terminology; list the steps in the lost foam casting process; state the advantages and disadvantages of using the lost foam casting process; and identifying the alloys that can be poured using this process.

In this module, the AFS 5100-12-S: Loss on Ignition (LOI) test will be performed. This module also incorporates the AFS 5101-12-S: Magnetic Material, Removal, and Determination sand test as part of the LOI test. Topics that will be covered: purpose of the tests, basic variables that factor into the tests, and performing the tests in a virtual environment. By the end of this module, you will be able to measure the weight change of a sample, consisting of weight losses and weight gains when a sample is fired at 1,800°F [982°C]. This includes weight loss due to volatilization of organics, weight loss due to removal of chemically bound water, weight loss due to dissociation or inorganic compounds with one or more components given off as a gas, and weight gain due to oxidation reactions (specifically chromite, olivine, and magnetite). You will also be able to remove magnetic materials in a sand sample and determine magnetic content.

This module will identify why aluminum metalcasting facilities heat treat castings. This module will look at the various operational costs, furnace maintenance, how to select a heat treatment furnace, and how to select various quenching media at a facility. By the end of this module, you will be able to identify direct costs in aluminum heat treating, explain the impact of maintenance on operating cost, describe the characteristics of various furnaces and ovens, explain the purpose of rigidity in heat treatment basket design, state the different quenching media, and describe the different types of quenching.
Mechanics for Heat Treatment: Aluminum Processes

This module will address the effects of temperature on aluminum parts in the treatment process, the variables and problems that arise in the daily operations of heat treating aluminum parts, and the operational issues related to installing and using heat treating equipment. By the end of this module, you will be able to explain good rack loading procedures, explain the solution heat treating process, describe residual stresses and ways to mitigate them, describe straightening methods, and explain furnace installation issues.

Melting and Pouring

This module addresses activities in the melt department of a metalcasting facility. It provides an overview of the process from the raw materials added to a furnace, to the adjustments made to the metal chemistry before consistently pouring molds. Safety issues regarding people, materials, and equipment are also highlighted. By the end of this module, you will be able to describe the melting process; identify the furnace types; state the advantages and disadvantages of each furnace type; explain how materials coming out of the furnace are adjusted; identify pouring methods; and state safety considerations.

Metalcasting Facility Safety

This module will describe the safety precautions one should take when working in or walking through a foundry or metalcasting facility. The cleaning room of a metalcasting facility was used as an example because it includes many of the hazards encountered in a metalcasting facility. This module will discuss general safety statistics, personal protection equipment (PPE), metalcasting facility hazards, and equipment safety. By the end of this module, you will be able to recognize potential safety hazards in the cleaning room of a metalcasting facility; describe the personal protective equipment (PPE) used in a metalcasting facility; and identify steps to take to reduce safety risks.

Methylene Blue Clay Test

In this module, the AFS 2210-00-S: Methylene Blue Clay Test, Ultrasonic Method, Molding Sand test will be performed. Topics that will be covered: purpose of the test, basic variables that factor into the test, and performing the test in a virtual environment. By the end of this module, you will be able to measure the amount of live (active) clay present in a sample of molding sand.

Moisture Determination for Sand Testing

In this module, the AFS 2216-00-S: Moisture, Infrared, Determination in Molding Sand test and the AFS 2219-00-S: Moisture Determination, Oven Method test will be performed. Topics that will be covered: purpose of the tests, basic variables that factor into the tests, and performing the tests in a virtual environment. By the end of this module, you will be able to determine the moisture content in foundry sand mixes and additives and determine the percentage of moisture in sand.
### AFS Institute

**e-Learning Modules**

<table>
<thead>
<tr>
<th>Module Code</th>
<th>Module Title</th>
<th>Categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>e78 nbme</td>
<td>Nobake Materials and Equipment</td>
<td>![Icon] ![Icon] ![Icon] ![Icon]</td>
</tr>
<tr>
<td>e79 nbmcd</td>
<td>Nobake Mold and Core Defects</td>
<td>![Icon] ![Icon] ![Icon] ![Icon]</td>
</tr>
<tr>
<td>e80 nbmcp</td>
<td>Nobake Molds and Core Process</td>
<td>![Icon] ![Icon] ![Icon] ![Icon]</td>
</tr>
<tr>
<td>e81 ord</td>
<td>Oxide Related Defects</td>
<td>![Icon] ![Icon] ![Icon] ![Icon]</td>
</tr>
<tr>
<td>e83 pmcp</td>
<td>Permanent Mold Casting Process</td>
<td>![Icon] ![Icon] ![Icon] ![Icon]</td>
</tr>
<tr>
<td>e84 pHS</td>
<td>pH of Sand</td>
<td>![Icon] ![Icon] ![Icon] ![Icon]</td>
</tr>
</tbody>
</table>

**Nobake Materials and Equipment**

In this module, the materials used in making nobake molds and cores will be identified. The equipment used throughout the nobake mold and core process will be explained. By the end of this module, you will be able to recognize the various types of raw materials and equipment used in the nobake mold and core making process.

**Nobake Mold and Core Defects**

This module will explore the various defects that occur in nobake molds and cores, such as slow cure defects, low strength or poor scratch defects, and lamination defects. The nine areas of quality control that must be addressed will be identified. By the end of this module, you will be able to evaluate nobake molds and cores for defects and determine the corrective action needed.

**Oxide Related Defects**

In this module, the different types of oxide-related defects will be defined and identified. This module will also identify the oxide-related defect causes and control measures to combat these defects. There will be a brief examination of certain gating system topics to understand how oxides can be affected by the gating system. By the end of this module, you will be able to identify the types of oxide-related defects and list two control measures for preventing oxides.

*Also available in Spanish.*

**Permanent Mold Casting Process**

This module defines the permanent mold casting process and identify the four steps of the casting process: preparation, filling, solidification, and ejection. This module will also identify key benefits of this process over other casting processes. By the end of this module, you will be able to identify the steps and key features/benefits of the permanent mold process, distinguish factors that may affect a mold during the preparation, filling, solidification, and ejection phases, and identify methods that aid in the solidification and cooling process.

**pH of Sand**

In this module, the AFS 5113-00-S: pH of Sand test will be performed. Topics that will be covered: purpose of the test, basic variables that factor into the test, and performing the test in a virtual environment. By the end of this module, you will be able to determine the alkalinity or acidity of sand, expressed in terms of pH.
## Purchasing Castings: Create the Relationship

**Categories:**

This module will define the purchasing casting process from the perspective of a new buyer-supplier relationship. This process includes the following segments: pre-procurement, supplier information gathering, supplier analysis, and supplier relationship. By the end of this module, you will be able to identify the key buyer and supplier roles; define key purchasing casting terminology; define the steps in the purchasing casting process; and provide the responsibilities of each role throughout the purchasing casting process.

## Purchasing Castings: Grow the Relationship

**Categories:**

This module will review the benefits of growing the relationship between a purchasing casting buyer and casting supplier. This module will also review the ways suppliers can impact a buying organization and discuss ways that both buyers and suppliers can grow their relationship. This module concludes with information strategies a buyer can take to help the supplier better understand their expectations. By the end of this module, you will be able to state the benefits of growing the relationship; list the ways that suppliers can impact the buying organization; list the ways that buyers can grow their relationship with the supplier; list the ways that suppliers can grow their relationship with the buyer; and state what the buyer can do to help the supplier understand their expectations.

## Purchasing Castings: Maintain the Relationship

**Categories:**

This module will discuss maintaining the purchasing casting buyer-supplier relationship and key terminology regarding maintaining the relationship. By attempting to understand the terms of the relationship between buyer and seller you will be gaining a greater insight into the basic workings of the economy. By the end of this module, you will be able to discuss the benefits of maintaining the relationship, discuss how to be a valued supplier, and identify supplier and buyer touchpoints.

## Risering Iron Castings

**Categories:**

This module identifies the uniqueness of feeding graphitic cast iron alloys. The three ways risers should be designed for cast iron will be explained along with the factors that affect volume change. By the end of this module, you will be able to list unique riser considerations for iron castings.

## Sand Related Defects

**Categories:**

The sand molding process and the four types of sand casting methods will be identified in this module. The three different types of sand-related defects: sand expansion; sand adhesion; and sand strength will be reviewed. Along with in-depth explanations of these defects, possible sand system control measures will be discussed to help avoid these defects. By the end of this module, you will be able to identify the three different types of sand-related defects and one control measure to implement, per sand-related defect.

*Also available in Spanish.*
Two tests will be performed in this module: AFS 1101-13-S: Sampling of Sand and AFS 1104-13-S: Sampling of Bagged Sand. Topics that will be covered: purpose of the tests, basic variables that factor into the tests, and performing the tests in a virtual environment. By the end of this module, you will be able to obtain a representative sample of free falling sand entering or exiting a bulk storage container (rail car, bin, barge, palletainer, intermediate bulk storage container, etc.) and obtain a sample of bagged sand which represents the lot from which the sample was obtained.

**Sand Sampling Methods**

**Categories:**

- Sand Sampling
- Sampling of Sand
- Sampling of Bagged Sand

**Sieve Analysis and Grain Fineness Number (AFS GFN)**

Two tests will be performed in this module: the AFS 1105-12-S: Sieve Analysis (Particle Determination of Sand) and the AFS 1106-12-S: Grain Fineness Number, AFS GFN, Calculation tests. Topics that will be covered: purpose of the tests, basic variables that factor into the tests, and performing the tests in a virtual environment. By the end of this module, you will be able to determine the particle size distribution of loose, dry sand using standard test sieves and calculate the AFS Grain Fineness Number (AFS GFN), an estimate of the average sieve size of a sand sample.

**Sieve Analysis and Grain Fineness Number (AFS GFN)**

**Categories:**

- Sieve Analysis
- Grain Fineness Number

**Shrink Related Defects**

In this module, shrinkage and the different types of shrink-related defects will be identified. This module will also identify the causes of these shrink-related defects. In addition, shrink defects will be distinguished from gas defects and shrink control measures will be described. The module will briefly examine some gating system topics and how shrinkage can be affected by the gating system. By the end of this module, you will be able to identify the types of shrink-related defects and list two control measures to preventing shrink defects.

**Shrink Related Defects**

**Categories:**

- Shrink
- Shrink Related Defects

*Also available in Spanish.*
Six Families of Cast Iron

This module will explore the designation systems and details of each of the six families of cast iron. The Introduction to Cast Iron module is a prerequisite for this module and incorporated in this module. By the end of the module, you will be able to identify how elements in cast iron are adjusted to produce different grades; explain the classification systems for each of the six cast iron families; and discuss the mechanical and physical properties of each of the six families of cast iron.

*Also available in Spanish.*

Steel Casting Alloys

This module will explore how steel is made and identify the differences between cast iron and steel. The different steel alloy types and properties will be explained. By the end of this module, you will be able to explain the chief properties and types of steel, as well as what properties distinguish it from cast iron.

Steel Casting Defects: Oxides and Inclusions

This module will explore oxides and inclusions that affect steel castings. This module will review the source of each of these defects and measures to take to control these defects. By the end of this module, you will be able to identify oxides and inclusions, how to determine the source, and how to prevent them. This module will also give you the opportunity to document causes of inclusions by working through a case study.

Steel Casting Defects: Shrinkage

In this module, the two types of steel shrinkage defects: macro and micro shrinkage porosity (voids) will be explored. This module will also identify control measures to reduce or eliminate shrinkage defects. By the end of this module, you will be able to: define macro and micro shrinkage porosity (voids) defects in steel and identify two control methods to reduce the defects.

Steel Casting Production

This module will explore the steel casting process, including: optimizing a design; patternmaking; mold and core making; melting and pouring; and cleaning and inspection. By the end of this module, you will be able to describe the main principles and features of the metalcasting and molding processes of steel.

Steel Casting Quality Requirements and Inspection Methods

In this module, the two types of steel inspection methods and the different types of chemical composition tests will be identified. By the end of this module, you will be able to identify industry requirements and standards for inspections and welding repairs and describe features of the chemical and mechanical testing of steel.
In this module, the AFS 3301-08-S: Tensile Strength, 1 in. Thick Tensile Specimen test will be performed. Prior to taking this module, you must complete the following sand test module: AFS 3315-00-S: Specimen Preparation, 1 in. Thick Specimen, Hot Box, Warm Box/Cold Box. This test is incorporated in this module. Topics that will be covered: purpose of the tests, basic variables that factor into the tests, and performing the tests in a virtual environment. By the end of this module, you will be able to determine tensile strength of 1 in. thick tensile specimens.

This module will define the term alloy and identify the seven common alloys seen in the metalcasting industry: aluminum, copper, iron, steel, zinc, magnesium, and superalloys. This module will also differentiate between the terms, ferrous and nonferrous. By the end of this module, you will be able to identify the seven alloys used in the metalcasting industry and describe why certain alloys are used.

Based on the latest metalcasting census data, this module will identify the top casting processes and briefly identify the various advantages and disadvantages for each process. By the end of this module, you will be able to identify the various casting processes available for producing a metalcasting and describe the advantages and disadvantages of each of the common casting processes.

This module will explore the different types tooling used in the metalcasting industry: permanent mold tooling, sand mold tooling, and investment pattern tooling. Common Tooling Department constraints will be described. By the end of this module, you will be able to identify and describe the types of tooling that are used with the major casting production processes.

In this module, the AFS 5202-09-S: Compression Strength, Green or Dried sand test will be performed. Prior to performing this test, you must complete the following sand tests: AFS 5222-13-S: 2 in. Diameter x 2 in. Specimen Preparation, Rammer Method and AFS 2251-00-S: Riddling, Molding Sand. These tests are incorporated in this module. Topics that will be covered: purpose of the tests, basic variables that factor into the tests, and performing the tests in a virtual environment. By the end of this module, you will be able to determine the compression strength of an AFS 2 in. Dia. x 2 in. specimen.

In this module, the AFS 2206-12-S: Tensile, Wet Molding Sand test will be performed. Topics that will be covered: purpose of the test, basic variables that factor into the test, and performing the test in a virtual environment. By the end of this module, you will be able to measure the wet tensile strength of bentonite-bonded molded sands.
This module will review the benefits and identify the design challenges regarding foam, coating, and glue considerations. By the end of this module, you will be able to describe the benefits of the lost foam casting process for aluminum castings; identify design considerations when creating a lost foam mold; and explain what considerations need to be made when creating a foam mold.

Lost Foam Design for Aluminum Castings

This e-Learning module will compare traditional casting methods and 3D sand printing. Topics will include part design, parting lines, casting filling and solidification, cores, undercuts, number of cores and undercuts, junctions, geometry orientation, and bosses and ribs. The module will also examine 3D sand printing mold design. The following topics will be discussed in this section: questions to ask the client, process to move from a CAD file to mold design, documenting the mold with text, assembly aids, lifting aids, building a virtual box, and designing for cleaning. Upon completion of this module, you will be able to demonstrate mold design techniques and describe material handling techniques for 3D sand printing.

3D Sand Printing Casting Design

This e-Learning module will explore the topic of gating design for 3D sand printing. The following topics will be addressed in this module: the 3D sand printing process, cooling, gating and feed-riser design, mold economics, and simulation. Upon completion of this module, you will be able to list design advantages special to 3D sand printing, describe the 3D sand printing process from design to production, and differentiate between conventional casting and 3D sand casting regarding gating and feed-risers.

Gating Design for 3D Printed Sand

This e-Learning module will explore 3D sand printing mold and core quality. The following topics will be addressed: elements of quality 3D sand printed molds and cores, standard cleaning and test procedures, potential defects of 3D Sand printed molds and cores, and lifting aids used with 3D sand printed molds and cores. Upon completion of this module, you will be able to identify best practices for quality molds and cores and select the tools used to ensure mold and core quality.

3D Sand Printing Mold Quality
<table>
<thead>
<tr>
<th>Módulo</th>
<th>Título</th>
<th>Categorías</th>
<th>Descripción</th>
</tr>
</thead>
<tbody>
<tr>
<td>e13</td>
<td>Prácticas Básicas de Fusión para Hierro</td>
<td></td>
<td>Se explicarán los diferentes procedimientos de fusión y vertido de hierro fundido junto con los ensayos de calidad (pre-vaciado y post-vaciado), velocidades de enfriamiento; y los tres tipos de tratamientos de fusión utilizados en las fundiciones. Al final de este módulo, podrá identificar cuatro métodos importantes de inspección / pruebas para determinar la calidad del hierro fundido y describir las prácticas básicas de fusión y las tecnologías relacionadas para el hierro fundido.</td>
</tr>
<tr>
<td>e17</td>
<td>Panorama General del Proceso de Fundición</td>
<td></td>
<td>En este módulo se identifican los procesos primarios y los procesos de producción posteriores al vaciado que se utilizan en una fundición de metales. Para el final del módulo, usted podrá definir los términos clave de la industria, describir los principales departamentos en una fundición de metales y realizar un seguimiento, de manera cronológica, desde el proceso de cotización, hasta la producción y el envío de partes vaciadas.</td>
</tr>
<tr>
<td>e19</td>
<td>Defectos en el Hierro Fundido: Contracción por Solidificación en Hierro Gris</td>
<td></td>
<td>En este módulo nos enfocaremos en los factores que afectan la contracción por solidificación en hierro gris. Discutiremos las diferencias entre el hierro puro y los hierros fundidos gráficos, las características únicas de los hierros grises, el intervalo del comportamiento para hierros grises sobre el intervalo normal de equivalente de carbono (CE), los efectos de la contracción por solidificación en la calidad de la pieza y la aparición de los defectos, y demás etapas y consideraciones para reducir el riesgo de defectos de contracción por solidificación. Al final de este módulo, usted podrá identificar dos medidas de control para reducir la contracción por solidificación en los hierros grises.</td>
</tr>
<tr>
<td>e22</td>
<td>Práctica para el Análisis de Defectos en Piezas y Conclusión</td>
<td></td>
<td>Este módulo se centrará en la práctica del uso del Procedimiento de 10-Etapas para analizar un defecto de pieza. Este módulo es la culminación de los cinco módulos anteriores. AFS recomienda completar los siguientes módulos antes de tomar este módulo:</td>
</tr>
<tr>
<td>e38</td>
<td>Elementos en el Hierro Fundido</td>
<td></td>
<td>En este módulo, se analizará el rol del carbono, del silicio, y los elementos de aleación en el hierro fundido. Este módulo concluirá con dos casos de estudio del mundo real que comparan diferentes grados de hierro fundido. Al finalizar el módulo, podrá analizar de qué manera los diferentes elementos afectan las propiedades del hierro fundido.</td>
</tr>
<tr>
<td>e42</td>
<td>Defectos Relacionados con el Gas</td>
<td></td>
<td>En este módulo, se identificarán las diversas fuentes de defectos relacionados con el gas y los tres tipos de defectos relacionados con el gas. En este módulo también se identificarán las causas de estos tres tipos de defectos y las medidas de control que se pueden adoptar en las fundiciones. Al final del módulo, podrá enumerar los tres tipos de defectos relacionados con el gas y dos medidas de control para cada defecto relacionado con el gas.</td>
</tr>
</tbody>
</table>
Compactación de Arena Verde

En este módulo, se explorarán los diferentes tipos de compactación de arena. Este módulo también explicará los métodos para prevenir y resolver problemas de compactación de la arena. Al final del módulo, podrá enumerar los cuatro métodos para compactar la arena para garantizar una calidad óptima de las piezas vaciadas.

Equipo de Moldeo de Arena Verde

Se identificarán las cinco piezas principales del equipo de moldeo necesarias para preparar un molde de arena verde de calidad, junto con técnicas adecuadas de mantenimiento de equipos. Este módulo además comprende una sección de seguridad opcional relacionada con los equipos de protección personal (EPP) y equipos de moldeo. Para el final del módulo, podrá describir las prácticas adecuadas para elegir, usar y mantener los equipos de moldeo de arena verde.

Preparación de Arena Verde y Control de Calidad

En este módulo, se explorará la secuencia de funcionamiento de los mezcladores con rueda horizontal y las pruebas básicas relacionadas con el control del proceso. En este módulo además exploraremos la resistencia de la arena verde y los diferentes requerimientos sobre las arenas para diferentes tipos de aleaciones. Al finalizar el módulo, el participante podrá analizar los problemas relacionados con las materias primas que pudieran afectar la calidad de los resultados del moldeo en arena verde.

Materias Primas de Arena Verde

En este módulo identificaremos los diferentes tipos de arena, arcilla y aditivos que se utilizan para realizar moldes de arena verde. Se analizarán las características y propiedades que afectan la compactabilidad y el rol del agua en el moldeo con arena verde. Al finalizar el módulo, el alumno podrá identificar y evaluar las materias primas utilizadas para elaborar moldes de arena verde de gran calidad.

Introducción al Hierro Fundido

En este módulo identificará las industrias que utilizan hierro fundido, los elementos de aleación utilizados en la producción de hierro fundido y las propiedades mecánicas y físicas del hierro fundido. Para el final del módulo, usted podrá describir los factores y las características críticas del hierro fundido que lo hacen la aleación de preferencia.
En este módulo, se examinarán por qué las instalaciones de fundición de metales tratan térmicamente sus piezas (con calor sus coladas). También definiremos los diversos ciclos de enfriamiento y calentamiento disponibles. Para el final del módulo, podrá explicar el uso del tratamiento térmico (con calor) en el hierro fundido y de qué manera afecta las propiedades mecánicas y el costo.

Introducción a los Tratamientos Térmicos de Fundición de Hierro

Introducción a la Fusión de Hierro Fundido

En este módulo se proporcionará un breve resumen del proceso de fundición de hierro fundido y los diversos tipos de hornos utilizados para la fundición del hierro fundido. Además, se indicarán las prácticas generales de seguridad mientras trabaja en el taller y se definirá cuándo visitar una instalación de fundición de metales. Para el final de este módulo, podrá explicar brevemente el proceso de fundición de metales del hierro fundido y aplicar procedimientos de seguridad a su entorno de trabajo diario.

Introducción a la Microestructura del Hierro Fundido

En este módulo se identificarán las diferencias entre diagramas de fases unario, binario, y ternario; se definirán los componentes de microestructuras en el diagrama de fases del hierro fundido y se explicará cómo y por qué se forman las microestructuras. Para el final de este módulo, usted podrá identificar los diagramas de fases unario, binario, y ternario.

Introducción al Análisis de Defectos de Fundición

Este módulo se divide en tres partes:

- Parte 1: Conozca a Metro Metalcasting, Inc.
- Parte 2: Categorización de los Defectos de Fundición
- Parte 3: Análisis de los Defectos de Fundición

La Parte 1 del módulo será una introducción a Metro Metalcasting, Inc. (una compañía ficticia) que tiene un alto porcentaje de defectos de fundición. Utilizando la técnica de formar un equipo para la solución a estos defectos, se presentará a los participantes un enfoque sistemático para el análisis y la reducción de los defectos de la fundición. El Procedimiento de 10-Etapas. En la Parte 2, se describirán las siete categorías de los defectos de fundición y los participantes se familiarizarán con el International Atlas of Casting Defects. En la Parte 3, los participantes aprenderán cómo usar el Procedimiento de 10-Etapas para resolver un defecto de fundición. Se le presentarán las herramientas utilizadas en cada una de las 10 etapas y cómo implementarlas. Para el final del módulo, podrá identificar el Procedimiento de 10-Etapas y utilizar dichas etapas para analizar un defecto de fundición.

Introducción a los Defectos de la Arena Verde

En este módulo, se identificarán las propiedades físicas y la inspección visual necesaria para analizar los defectos de la arena verde. En este módulo además se describirán las causas de los defectos más comunes de la arena verde. Al final del módulo podrá identificar un defecto de contracción, un defecto de porosidad por gas, un defecto de adherencia de la arena, un defecto de resistencia de la arena y un defecto de expansión de la arena.
En este módulo, se definirán e identificarán los diferentes tipos de defectos relacionados con el óxido. En este módulo también se identificarán las causas de los defectos relacionados con el óxido y las medidas de control para combatir estos defectos. Habrá un breve examen sobre determinados temas del sistema de alimentación para comprender de qué manera este puede ser afectado por el óxido. Al final del módulo, podrá identificar los tipos de defectos relacionados con el óxido y dos medidas de control para evitar el óxido.

En este módulo, se definirá e identificará la contracción y los diferentes tipos de defectos relacionados con esta. En este módulo además se identificarán las causas de los defectos relacionados con la contracción. Además, se distinguirán los defectos derivados de la contracción de los defectos del gas y se describirán las medidas de control de contracción. En este módulo se examinarán brevemente algunos temas del sistema de alimentación y de qué manera la contracción se puede ver afectada por el sistema de alimentación. Al final del módulo, podrá identificar los tipos de defectos relacionados con la contracción y dos medidas de control para evitar los defectos de contracción.

En este módulo, el proceso de moldeo en arena y los cuatro tipos de métodos de fundición en arena se identificarán en este módulo. Tres tipos diferentes de defectos relacionados con la arena: expansión de arena; adhesión de arena; y la resistencia de la arena será revisados. Además, se proporcionará una explicación a profundidad de estos defectos, se discutirán las posibles medidas de control del sistema de arenas para ayudar a evitar estos defectos. Al final de este módulo, podrá identificar los tres tipos diferentes de defectos relacionados con la arena y una medida de control para implementar, por defecto relacionado con la arena.

En este módulo exploraremos los sistemas de designación y los detalles de cada una de las seis familias de hierro fundido.

El módulo Introducción al Hierro Fundido es un prerequisito para este módulo y se ha incorporado aquí. Al finalizar el módulo, podrá identificar de qué manera se ajustan los elementos en el hierro fundido para producir diferentes grados, explicar los sistemas de clasificación para cada una de las seis familias de hierro fundido, y analizar las propiedades físicas y mecánicas de cada una de las seis familias de hierro fundido.