



<b>Course Code</b> 4-215	<b>CEUs</b> 1.3 CEUs
-----------------------------	-------------------------

### Course Introduction

This course provides participants with the scientific principles needed to understand the metallurgy of important aluminum-based casting alloys. Its primary purpose is to facilitate an understanding of the chemical and thermal fundamentals which control structures formed during aluminum solidification. Topics include phase diagrams, thermal analysis, segregation, dendritic solidification and heat treatment.

**Benefits to Taking the Course:** Benefits to taking this course include attaining the knowledge and skills needed to interact with analysis laboratories and customers in an informed manner, modify process parameters and adjust casting properties to meet customers' requirements, and better understand and solve production problems in the future.

### Learning Outcomes

1. Read unary and binary phase diagrams to predict the phases (structures) that form during solidification.
2. Describe how phase diagrams and cooling curves can be used to determine the sources of castability issues.
3. Describe how solidification impacts casting properties.
4. Describe the effects of grain refiners and modifiers on microstructures.
5. Describe how melt treatment, such as degassing, fluxes, and filtration, can impact casting properties.
6. Describe the types and applications of common melt quality and casting analysis techniques.
7. Explain how the heat treatment tempers affect microstructure and mechanical properties of cast aluminum alloys.

### Lesson Outline

Module 1: Introduction

Module 2: Filling, Feeding and Solidification

Cooling curves and phase diagrams

Modes of solidification

Grain structure

Elements of a cast microstructure

Module 3: Grain Refinement & Modification

Thermal analysis

Grain refinement, grain refiners and refined microstructures

Modification, silicon modifiers and modified microstructures

Effects of grain refinement and modification on casting properties

AFS Rating System for Grain Refinement and Modification

Module 4: Impacts of Melt Treatment

Hydrogen and degassing

Dross and fluxes

Inclusions and filtration

Module 5: Melt Quality and Casting Analysis

Relationship between casting quality and the melt process

Melt quality analysis techniques

Mechanical testing methods

<p>Casting Inspections</p> <p>Module 6: Heat Treatment</p> <p>Heat treatable alloy systems</p> <p>Heat treatment processes and tempers</p> <p>Process control for heat treatment</p> <p>Casting issues, properties and applications of common alloy systems</p> <p>Module 7: Conclusion</p>
<p><b>Instructional Methods:</b></p> <ul style="list-style-type: none"> <li>• Class discussion</li> <li>• Small group, pairs and individual activities</li> <li>• Case studies</li> <li>• Q &amp; A sessions</li> </ul>
<p><b>Assessment Methods:</b></p> <ul style="list-style-type: none"> <li>• Individual exercises review</li> <li>• Case study debrief</li> <li>• Knowledge checks</li> <li>• Facilitator observation</li> <li>• Small group and pair exercise reviews</li> <li>• Q &amp; A sessions</li> </ul>
<p><b>Course Prerequisites:</b></p> <p>* Recommended prerequisites are Aluminum 101 and Aluminum Melting 201.</p>
<p><b>Pre-course Activities:</b></p> <p>A pre-course assignment consisting of reading and questions, will be provided at the time of registration and should be completed prior to attending the course, especially for those who have not taken the recommended prerequisite courses.</p>
<p><b>Texts, Books or other Resources available for purchase:</b></p> <ul style="list-style-type: none"> <li>• G. K. Sigworth: "Best Practices in Aluminum Metalcasting," American Foundry Society, 2014  <a href="https://hub.afsinc.org/NC_Product?id=a2Z1a000000ACp8EAG">https://hub.afsinc.org/NC_Product?id=a2Z1a000000ACp8EAG</a></li> </ul>
<p><b>Attendee Requirements to Earn CEUs:</b></p> <ol style="list-style-type: none"> <li>1. Present at least 11.5 hours of the 13 hours of instructional time (90%), which does not include meals or breaks.</li> <li>2. Active participation (can include asking questions, communicating with other attendees during and taking part in group activities, providing responses during whole class or group discussions).</li> <li>3. Successful achievement of learning outcomes.</li> </ol>
<p><b>Who Should Attend?</b></p> <p>The target audience for this course consists of individuals with no prior training in aluminum metallurgy, those responsible for metallurgical and/or quality control and anyone wanting to learn about aluminum metallurgy.</p>