

Course Code 3-215	CEUs 1.2 CEUs
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Course Introduction

This course will provide participants with the knowledge and skills regarding 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.

Benefits to Taking the Course: Benefits to taking this course include hands on identification of the basic phases on the iron-carbon phase diagram; identifying major phases and characteristics from microstructures; explaining solidification behaviors and reactions; identifying preparation and analysis techniques of metallographic samples; and discussing iron casting defect specifically related to metallurgy.

Learning Outcomes

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

Lesson Plan

Module 1: Introduction

Module 2: Introduction to Equilibrium (Phase) Diagrams

Lesson 1: Basic Concepts

Lesson 2: 2-Component Systems

Module 3: The Iron-Carbon System

Lesson 1: Phase Fields on the Fe-C Equilibrium Diagram

Lesson 2: Metallographic Appearance of Major Phases

Module 4: Eutectic Solidification

Lesson 1: Definitions and Eutectic Reactions in Cast Irons

Lesson 2: Basic Concepts of Cast Iron Solidification

Lesson 3: Undercooling

Module 5: Graphite Shape in Gray and Ductile Iron

Lesson 1: Nucleation of Graphite during Solidification

Lesson 2: Growth of Graphite during Solidification

Module 6: Effects of Carbon, Silicon, and Other Elements on Solidification

Lesson 1: Effect of Silicon on Fe-C Phase Diagram

Lesson 2: Casting Properties

Lesson 3: Effect of Some Other Elements

Module 7: The Eutectoid Reaction in Cast Irons

Lesson 1: The Generic Eutectoid Reaction Lesson 2: Pearlite-stabilizing Elements Module 8: Insights on Mechanical Testing Lesson 1: Tensile Testing Lesson 2: Hardness Testing Lesson 3: Impact Testing Module 9: Iron Related Casting Issues Lesson 1: Porosity/Cavity Defects Lesson 2: Abnormal Graphite Types Lesson 4: Poor Machinability Module 10: Conclusion
Instructional Methods: • Lecture • Whole class discussion • Group activities • Demonstrations • Practice activities
Assessment Methods: No formal assessment will take place in this course; however, attendees will participate in informal activities such as knowledge check and Q&A sessions with the facilitator to verify that learning outcomes are being met. Assessment of successful achievement of learning outcomes must be included throughout the course in order to meet the ANSI/IACET 1-2013 standard for continuing education programs and for CEUs to be awarded.
Recommended Course Prerequisites: • <i>Iron 101</i> (Institute course) • <i>Iron Melting 201</i> (Institute course)
Pre-course Activities: • Complete the pre-reading assignment, which will be emailed upon registration.
Attendee Requirements to Earn CEUs: 1. Present at least 11 hours of the total 12 hours of instructional time (90%), which does not include meals or breaks. 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). 3. Successful achievement of learning outcomes.
Who Should Attend? The target audience consists of people in the following positions: • Process engineers • Process technicians • Metallurgists • Metalcasting facility workers • Quality control personnel • Melting and casting supervisor • Melters • Anyone wanting to learn the basics of iron metallurgy