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Northeast Wisconsin Technical College

10-422-100 061845 Metallurgy

Course Outcome Summary

Course Information

Description 10-422-100 METALLURGY ...manufacture of iron and steel, mechanical and physical properties of metals, metal identification, macro and microscopic grain structures, welding metallurgy, applied heat treating processes, and weld failures and fractures.

Total Credits 2

Total Hours 54

Course History

Last Revision Date 2/7/2023

Course Competencies

1. Identify the metals commonly used by industry.

Assessment Strategies
Paper

Learning Objectives
1.a. Identify the metals on the periodic table of elements.
1.b. Describe the characteristics that all metals share.
1.c. List the most common base metals.
1.d. Describe the most important alloy metals.
1.e. Identify the toxic elements encountered in welding.
1.f. Identify Materials Visually.

Criteria
1.1. Identify base metals Fe, Al, Mg, Cu and Ti.
1.2. Identify the alloying effects of C, Mn, V, Cr, Ni, Mo, Si, S and P.
1.3. Locate the metals on the periodic table.
1.4. Identify Cr, Mn, Zn, Cd and Pb.
1.5. Compare tight and loose metallic oxides.
1.6. Visualize atoms in a liquid.
1.7. Visualize metallic atoms bonded in a crystal.
1.8. Compare molten steel to a liquid solution of coffee and sugar.

2. Describe the manufacturing process of iron and steel.

Learning Objectives
2.a. Describe how iron ores are extracted and refined.

2.b. Explain the function of a blast furnace.
2.c. Describe hot rolling and its effect on grain size.
2.d. Describe cold rolling and its effect on grain size.
2.e. Identify common structural shapes.
2.f. Describe welded and seamless pipe.
2.g. Compare the casting and forging processes.

Criteria

2.1. View iron, copper, nickel and molybdenum mines on Google Earth.

2.2. Describe the reactions that take place in a blast furnace.
2.3. Describe limits of low, medium and high carbon steel.
2.4. Describe the SAE and ASTM classification systems.
2.5. Describe Continuous casting.
2.6. Describe hot working and cold working and its effects on steel.

2.7. Describe sand and die casting processes.

3. Identify the mechanical and physical properties of metals.

Learning Objectives

3.a. Operate hardness testing equipment.
3.b. Identify the strengths of metals.
3.c. Witness a tensile test.
3.d. Witness a Charpy impact test.

Criteria

3.1. Define slip plane, interstitial space, slip and plastic deformation.
3.2. Describe the Schore hardness testing system.
3.3. Describe the relationship between strength, hardness and toughness.
3.4. Compare Rockwell, Brinell and Vickers hardness testing systems.
3.5. Locate elastic limit, yield point, UTS ,breaking point on stress/strain diagram, Calculate 2% offset yield, UTS and % elongation.
3.6. Describe the Charpy impact test.
3.7. Define thermal conductivity and expansion.
3.8. Define fatigue and creep.

4. Describe the effects of heat and cooling rates on the microstructure of carbon steel.

Learning Objectives

4.a. Define hardenability and carbon equivalence.
4.b. Demonstrate the formation of martensite.
4.c. Demonstrate the effects of a slow cool.
4.d. Describe the effects of heat on grain size.
4.e. Realize the importance of preheat and postheat.

Criteria

4.1. Describe how to harden steel.
4.2. Describe how to soften steel.
4.3. Describe how to toughen steel.

5. Analyze Macro and micro etch steel and aluminum.

Learning Objectives

5.a. Record the variables of a weld.
5.b. Safely operate grinding and polishing equipment.
5.c. Safely perform etching process.
5.d. Identify the fusion zone of a weld.
5.e. Identify common weld discontinuities.
5.f. Identify the heat affected zone.

Criteria

5.1. Identify grit size.
5.2. Demonstrate correct grinding techniques.
5.3. Demonstrate correct polishing techniques.
5.4. Demonstrate correct etching techniques.
5.5. Identify a casting.

5.6. Identify weld metal.
5.7. Identify a HAZ.