

**National Resource Center for Materials Technology Education
Core Competencies for General, Materials and Marine Technicians
Tidewater Community College Maritime Industry Focus Group
March, 2010**

		Classification System:	Importance	Gen- -eral	Mater -ials	Marine		
		19 Categories 0, 1, 2, etc.	Rating Scale:					
		75 Competency Concentrations A, B, C, etc.	1 = vital	Tech	Tech	Tech		
		386 Performance indicators a1, a2, a3, etc.	2 = important	G	M			
			3 = desirable					
		Each competency begins with "ability to"	4 = unimportant					
Category	Competency Concentration Area					Importance		
0	BASIC COMPETENCIES RELATED TO WORK AS A TECHNICIAN					G	M	Marine
A	Demonstrate Good Communication Skills					1	1	1
	a1	Demonstrate ability to listen and comprehend instructions				1	1	1
	a2	Demonstrate ability to read and comprehend English				1	1	1
	a3	Interpret specific instructions from supervisor				1	1	1
	a4	Demonstrate ability to write clear letters, instructions, reports				2	1	1
	a5	Use e-mail, FAX and other electronic means of communication				2	2	2
	a6	Communicate non-documented process to fellow employees or supervisors				2	2	2
	a7	Read non-English information such as materials specifications				3	2	2
B	Prepare Tests and Analyze Data					1	1	1
	b1	Prepare tests and record test details and data neatly and accurately				1	1	1
	b2	Demonstrate good lab notebook skills				1	1	1
	b3	Analyze test data, compare and contrast information, draw rational conclusions				2	1	1
C	Demonstrate Good Workplace Performance Methods					1	1	1
	c1	Demonstrate good workplace safety methods				1	1	1
	c2	Recall company practices on timeliness, attendance, punctuality, diversity, confidentiality				1	1	1
	c3	Practice good time management and housekeeping skills				1	1	1
	c4	Work effectively in teams within the workforce or group				1	1	1
	c5	Demonstrate flexibility, willingness to learn and ability to solve problems				1	1	1
	c6	Recognize what needs to be done to solve a problem and take steps to accomplish it				1	1	1
	c7	Exercise independent judgment and willingness to assume responsibility				2	1	1
	c8	Apply problem solving methods and continuous improvement techniques				2	2	2
	c9	Perform job functions demanding manual dexterity, dynamic and explosive strength				2	2	2
	c10	Effectively break out non-documented tasks into a series of tasks or activities				2	2	2
D	Demonstrate General Technical Competence					1	1	1
	d1	Recall key job-related information (processes, references, terminology, acronyms)				1	1	1
	d2	Show good observations skills during demonstrations of processes or equipment operation				1	1	1
	d3	Perform troubleshooting of equipment and instrumentation				1	1	1
	d4	Perform basic setup, diagnosis and repair of industrial machinery and equipment				1	1	1

	d5	Use vendor catalogs to acquire materials and components for work tasks	2	2	2
	d6	Identify the need and process for the removal of hazardous materials (RoHM)	2	2	2
1		MEASUREMENT AND BASIC TECHNICAL SKILLS			
A		Carry Out Measurements of Dimensions and of Physical Phenomena	1	1	1
	a1	Measure accurately hardness, impact strength and related properties of materials	2	1	1
	a2	Measure accurately tensile, compressive and shear properties of materials	2	1	1
	a3	Measure accurately dimensions using scales, micrometers and related tools	1	1	1
	a4	Demonstrate knowledge of order of magnitude of measurements and scales	1	1	1
	a5	Measure accurately temperature, pressure, force, torque and related quantities	1	1	1
	a6	Perform tests of physical properties such as density, viscosity, pH, etc.	2	1	1
	a7	Use correct terms for weight, mass and density in technical tasks	1	1	1
	a8	Measure accurately mass using appropriate devices	2	1	1
	a9	Perform calibration of instruments and describe the importance of proper calibration	1	1	1
	a10	Describe the difference between precision and accuracy	2	1	1
	a11	Apply precision metrology devices and inspection tools	2	2	2
	a12	Describe and apply effectively a variety of types of thermocouples	2	2	2
	a13	Use and apply vapor pressure data for water, solvents and other liquids	3	3	3
B		Interpret Technical Drawings	2	2	2
	b1	Read and interpret technical drawings	1	1	1
	b2	Interpret and apply tolerances on component dimensions and specifications	2	2	2
	b3	Read specifications on non-English technical drawings	3	3	3
1		Measurement and Basic Technical Skills, continued	G	M	Marine
C		Demonstrate Laboratory Skills	2	1	1
	c1	Demonstrate familiarity with good laboratory practice	1	1	1
	c2	Use a microscope for measurement and observation of material structures	2	1	1
	c3	Operate a digital camera to obtain high quality images of technical objects	2	1	1
	c4	Select appropriate devices and instruments for measurement of physical phenomena	2	1	1
	c5	Operate successfully basic shop machinery and tools	1	2	2
	c6	Operate air and gas flow systems and pressure and flow regulators	2	2	2
	c7	Operate vacuum equipment and read vacuum data in appropriate units	2	2	2
	c8	Practice good operating methods in clean rooms	2	2	2
D		Apply Electrical Phenomena to Physical Measurements	2	2	2
	d1	Use a digital millimeter for measurement of resistance, current , voltage and continuity	2	2	2
	d2	Use sensors for measurement of physical phenomena	2	2	2
	d3	Measure electrical conductivity and other electrical properties of materials	2	2	2
	d4	Apply principles of electricity and electronics to measurement and equipment operations	2	2	2
	d5	Perform successfully soldering operations for electrical connections	2	2	2
	d6	Analyze and apply basic DC and AC circuits	2	2	2
	d7	Demonstrate proper use of the electrical relationship $V = IR$	2	2	2
	d8	Perform electrical circuit bread boarding	3	2	2
2		MATHEMATICS, CALCULATIONS AND DATA SYSTEMS			
A		Apply Basic Mathematics Fundamentals	1	1	1
	a1	Demonstrate mastery of basic arithmetic, including proportions, percentages,	1	1	1

		etc			
	a2	Show that data, calculations and results are reasonable	1	1	1
	a3	Use mental arithmetic and calculators as computation tools	1	1	1
	a4	Prepare and interpret graphs using a variety of scales and presentation techniques	2	1	1
B		Demonstrate Proper Use of Units and Conversions	1	1	1
	b1	Manipulate and report accurately units for all calculations	1	1	1
	b2	Perform conversion of units from one systems to another	1	1	1
	b3	Demonstrate use of significant figures, accuracy and precision	1	1	1
	b4	Use accurately both U.S. customary units and the International System of Units (ISU)	2	1	1
C		Apply Geometry and Trigonometric Functions	2	2	2
	c1	Utilize concepts of perimeter, area and volume of basic shapes	1	1	1
	c2	Apply concepts of angles and triangles	2	2	2
	c3	Demonstrate concepts of trigonometry, including sine, cosine, tangent and related functions	2	2	2
D		Demonstrate Appropriate Use of Algebra and Functions	2	2	2
	d1	Apply concepts of algebra to solve equations for desired results	2	2	2
	d2	Demonstrate proper use of slope and rate of change	2	2	2
	d3	Analyze functions such as linear, exponential, quadratic, polynomial and logarithmic	2	2	2
	d4	Work effectively with inequalities	3	2	2
E		Demonstrate Appropriate Use of Statistics	2	2	2
	e1	Compute the mean, median and standard deviation of data sets	2	1	1
	e2	Apply the fundamentals of statistics and probability	2	2	2
	e3	Make inferences based on data analysis and measurements of variability	2	2	2
	e4	Apply concepts of the normal curve	2	2	2
3		COMPUTER SKILLS			
A		Practice Appropriate Computer Skills and Uses	1	1	1
	a1	Exercise understanding of inappropriate usages of computer systems	1	1	1
	a2	Demonstrate adherence to computer security policies	1	1	1
	a3	Demonstrate good keyboard skills	1	1	1
	a4	Use e mail and text messaging effectively and with good grammar and spelling	2	1	1
B		Demonstrate Use of Computer Applications	2	1	1
	b1	Create and use spreadsheets for data analysis, graphing, record keeping and other uses	2	1	1
	b2	Use the internet effectively for researching and acquiring technical information	2	1	1
	b3	Create quality written documents using word processing	2	1	1
3		Computer Skills, continued	G	M	Marine
B		Demonstrate Use of Computer Applications, continued	2	1	1
	b4	Create and use database applications (Marine =Use, not create)	2	1	1
	b5	Integrate documents containing word processing, spreadsheets and graphics	2	2	2
C		Apply Technical Software to Practice	2	2	2
	c1	Use commercially available software for analysis, data acquisition and similar tasks	2	2	2

	c2	Create and modify technical drawings using computer aided design, including 3D modeling	2	2	2
	c3	Demonstrate use of computational software such as Matlab, MathCAD, finite element analysis	3	2	2
4		Teamwork, Professionalism, Globalism and Multicultural Skills			
A		Demonstrate Effective Work With Teams	1	1	1
	a1	Work productively in an industrial team environment	1	1	1
	a2	Demonstrate understanding of the behavior of successful teams	1	2	2
	a3	Manage conflict effectively and with sensitivity to the needs and perceptions of others	1	1	1
B		Determine and Develop Effective Project Interactions	2	2	2
	b1	Plan and track work flow using the principles of project management (Marine-not necessary to plan and track, just use)	2	2	2
	b2	Describe the functions of various departments commonly found in industry	2	2	2
	b3	Plan effective agendas for meetings	2	2	2
	b4	Conduct effective meetings (Marine- how to attend and behave at a meeting)	3	2	2
C		Show Personal Professionalism	1	1	1
	c1	Manage time efficiently	1	1	1
	c2	Demonstrate adherence to the human resource policies of the employer	1	1	1
	c3	Practice proper personal hygiene	1	1	1
	c4	Effectively adopt and adapt skills and knowledge acquired during training	1	1	1
	c5	Display the personal and ethical characteristics necessary to be identified as a professional	1	1	1
	c6	Describe the practice the basic principles of intellectual property protections	2	2	2
	c7	Demonstrate life-long learning and plan and track personal professional growth	2	2	2
	c8	Demonstrate good presentation skills for small groups and larger audiences	2	2	2
D		Demonstrate Cultural Awareness in the Workplace	2	2	2
	d1	Demonstrate awareness of cultural differences to facilitate effective communication among workers	2	2	2
	d2	Apply a basic understanding of human behavior in dealing with workplace issues	2	2	2
E		Recognize Where a Global Perspective Should Be Used in the Workplace	2	2	2
	e1	Demonstrate basic knowledge of the global economic system	2	2	2
	e2	Demonstrate basic understanding of global economic trends	2	2	2
	e3	Identify key elements of import and export strategies and global trade issues	3	3	3
5		CHEMICAL SCIENCE SKILLS			
A		Apply Safe and Environmentally Appropriate Methods to Chemical Handling	1	1	1
	a1	Demonstrate safe handling of acids, bases, flammable liquids, cryogenic fluids and compressed. gasses	1	1	1
	a2	Apply safely the information available in Material Safety Data Sheets	1	1	1
	a3	Apply knowledge of chemical and environmental safety including waste disposal and recycling	1	1	1
	a4	Define flammability hazards of solvents such as flash point and explosive potential	2	1	1
	a5	Demonstrate understanding of the interactions of science and technology	2	2	2

		with society			
B		Demonstrate Knowledge of Chemistry Fundamentals	2	1	1
	b1	Read basic chemical compound abbreviations, e.g.HCl as hydrochloric acid	2	1	1
	b2	Demonstrate knowledge of chemical symbols and the periodic table of the elements	2	1	1
	b3	Demonstrate understanding of chemical concentrations and what they mean	2	1	1
	b4	Explain the importance of material compatibility	2	1	1
	b5	Apply the scientific method in a laboratory and in a variety of technical situations	2	1	1
	b6	Describe the fundamental nature of liquids, solids and gasses	2	1	1
	b7	Describe and compare the nature of organic and inorganic chemicals	2	2	2
	b8	Prepare an etching solution	3	2	2
	b9	Demonstrate knowledge of corrosion potential, chemical batteries and galvanic series	3	2	2
	b10	Describe the chain structure of polymers	3	3	3
5		Chemical Science Skills, continued	G	M	Marine
C		Describe Atomic and Nuclear Structure and Radioactive Decay	3	2	2
	c1	Describe the basic characteristics of electrons, neutrons and protons in atomic structure	3	2	2
	c2	Describe the characteristics of radioactive decay	3	3	3
6		PHYSICAL SCIENCE SKILLS			
A		Apply Basic Concepts of Mechanics	2	2	1
	a1	Apply correctly appropriate units for physical quantities	2	1	1
	a2	Use correctly the concepts of weight and mass	2	1	1
	a3	Apply principles of force, moments and static equilibrium	2	2	1
	a4	Explain the principles of the concept of frictions	2	2	1
	a5	Demonstrate and apply Newton's law $F = ma$	2	2	1
	a6	Apply fundamentals of potential and kinetic energy and of conservation of motion	2	2	1
	a7	Apply fundamentals of motion: velocity, acceleration, momentum, including rotational motion	2	2	1
	a8	Explain the concept of inertia and its relationship to acceleration and other forces	2	2	1
B		Apply Concepts of Fluids, Heat and Thermal Conduction	2	2	2
	b1	Apply concepts of heat, including temperature, thermal conductivity, specific heat, etc.	2	1	1
	b2	Use concepts of thermal expansion and differential thermal expansion	2	2	2
	b3	Demonstrate concepts of fluid pressure and behavior of fluids in annealing and heat treating	3	2	2
C		Describe and Apply Concepts of Electricity and Magnetism	2	2	2
	c1	Describe concepts of electromagnetic waves: x-rays, UV, radio waves and visible light	2	2	3
	c2	Explain the electrical properties of conductors, insulators and semiconductors	2	2	1
	c3	Apply concepts of magnetism and its role in motors and other phenomena	2	2	1
D		Apply Concepts of Light and Sound	2	2	2
	d1	Apply concepts of light and optics as applied to physical measurements (for QA)	2	2	1

	d2	Demonstrate concepts of sound measurement and control (for QA)	2	2	1
7		FUNDAMENTALS OF MATERIALS SCIENCE AND ENGINEERING			
A		Identify the General Nature of Metals	2	1	1
	a1	Recognize the general nature and available types of non-ferrous metals	2	1	1
	a2	Describe the general nature of ferrous metals	2	1	1
	a3	Explain what can be learned about a metal alloy from its phase diagram	2	1	1
	a4	Discuss the general nature of magnetic materials	2	2	1
B		Discuss the General Nature of Plastics and Polymers	2	1	1
	b1	Explain the general behavior of thermoplastic materials	2	1	1
	b2	Describe the general behavior of thermoset plastics	2	1	1
	b3	Recognize the differences between plastics and elastomers	2	2	2
C		Describe the General Nature of Composite Materials	2	2	1
	c1	Discuss the general nature of fiber-reinforced composites	2	2	1
	c2	Describe the nature of structural foam composite materials	2	2	1
	c3	Recognize other types of composites and how they differ from one-another	2	2	1
D		Identify the General Nature of Semiconductors and Optical Materials	3	2	1
	d1	Describe the nature of semiconductors and other materials used in electronic devices	3	2	1
	d2	Describe the nature of optical materials used in optics and in displays	3	2	1
	d3	Explain the structure and properties of optical fibers	3	2	1
E		Describe the General Nature and Behavior of Ceramics and Glasses	2	2	1
	e1	Discuss the general nature and properties of ceramic materials	2	2	1
	e2	Explain the general behavior of glasses	2	2	1
F		Identify the General Nature and Properties of Other Materials used in Engineering	3	2	1
	f1	Describe the nature of wood and its derivatives	3	2	1
	f2	Explain the general nature of concrete	3	2	1
7		Fundamentals of Materials Science and Technology, continued	G	M	Marine
G		Define Stress and Strength	2	1	1
	g1	Define stress	2	1	1
	g2	Explain the terms 'ultimate tensile strength' and 'ultimate compressive strength'	2	1	1
	g3	Define yield stress and yield strength for metals and identify materials that exhibit this property	2	1	1
	g4	Differentiate yield point for metals and identify materials that exhibit this property	2	1	1
	g5	Explain the term 'impact strength'	2	1	1
	g6	Define residual stress	2	1	1
	g7	Define endurance strength and describe S-N curves and fatigue failure	2	2	1
	g8	Explain shear stress and shear strength and how they differ from other measures of strength	2	2	1
H		Define strain and deformation	2	1	1
	h1	Define strain	2	1	1
	h2	Describe and compare the behavior of ductile and brittle materials	2	1	1
	h3	Identify the modulus of elasticity in tension, compression and in shear deformation	2	1	1

	h4	Define ductility and percent elongation	2	1	1
	h5	Define creep in materials	2	1	1
	h6	Explain the term 'percent reduction in area'	2	1	1
	h7	Describe the mechanisms of fracture in brittle and ductile materials	2	1	1
	h8	Define toughness of a material	2	1	1
I		Explain Causes for Differing Materials Properties	2	2	2
	i1	Compare mechanical properties of different classes of materials	2	2	1
	i2	Describe how polymer and composite properties differ from metals and ceramics	2	2	1
	i3	Explain property variations caused by annealing, heat treatment and deformation	2	2	1
	i4	Describe the types of flaws that can occur and how they can affect material properties	2	2	1
	i5	Identify methods used to vary the strength and toughness of materials	2	2	1
	i6	Describe differing modes of wear and material loss in different materials	2	2	1
	i7	Explain the process of environmental embrittlement	2	2	1
J	j1	Demonstrate how Materials Properties are Used in Engineering Design	2	2	2
	j2	Describe how the grain structure of a material can affect properties	2	1	1
	j3	Explain the process of designing materials for specific applications	2	2	2
	j4	Explain how and why a designer chooses properties of materials	2	2	2
	j5	Define strength-to-weight ratio and its significance in materials performance	2	2	2
	k5	Explain materials process for specialty welding applications			1
K		Compare Thermal, Physical and Other Properties of Materials	2	2	1
	k1	Describe flammability and toxicological issues in materials	2	2	1
	k2	Compare electrical properties of different metals, ceramics, polymers and composites	2	2	1
	k3	Describe differing thermal properties of different materials	2	2	1
	k4	Discuss optical and magnetic properties of differing classes of materials	2	2	1
M		Describe the General Nature and Behavior of Emerging Engineering Materials	3	2	1
	m1	Explain similarities and differences between biological and engineering materials	3	2	1
	m2	Describe the general nature of biocompatibility of materials	3	2	1
	m3	Explain the nature of nano-scale materials and how they differ from other materials	3	2	1
	m4	Discuss the general nature of microelectromechanical systems (MEMS)	3	2	1
	m5	Discuss the nature and behavior of shape-memory alloys	3	2	2
8		MATERIALS TESTING	G	M	Marine
		Maritime-Section A done by others, not technicians			
A		Demonstrate the Planning and Execution of Materials Experiments	2	1	NA
	a1	Prepare material samples for analysis of grain structure and failure sites	2	1	
	a2	Demonstrate use of image analysis software	2	1	
	a3	Demonstrate a basic understanding of solidification principles and processes	3	1	
	a4	Explain methods to determine composition of materials	3	1	
	a5	Determine best means for preparing different materials for testing	2	1	
	a6	Demonstrate an understanding of experimental design	2	2	
	a7	Recognize and decipher acronyms used for job tasks	2	2	
		Maritime-Section B done by others, not technicians			

B		Apply Mechanical Testing Processes to Solid Materials	2	1	NA
	b1	Describe the types of materials properties found from a tensile test	2	1	
	b2	Perform tensile tests on a variety of materials	2	1	
	b3	Describe methods for measuring hardness of materials	2	1	
	b4	Perform hardness tests for a variety of materials	2	1	
	b5	Describe the measurement of impact strength using Charpy and Izod methods	2	1	
	b6	Perform impact tests on a variety of materials	2	1	
	b7	Demonstrate basic knowledge of microhardness measurements and hardness profiles	2	1	
	b8	Perform fatigue testing on materials	2	1	
	b9	Perform life testing, shock, vibration and thermal shock tests on materials	2	2	
		Maritime-Section C done by others, not technicians			
C		Perform Visual and Nondestructive Testing Methods for Solids	3	1	NA
	c1	Prepare a materials specimen for metallurgical analysis	3	1	
	c2	Perform an optical microscopic evaluation of a metallurgical specimen and report the results	3	1	
	c3	Describe the effects of processing on the microstructure of materials	3	1	
	c4	Use effectively electron microscopes and similar instrumentations	3	1	
	c5	Perform nondestructive testing using ultrasonic, x-ray, eddy current and related methods	2	1	
	c6	Demonstrate proficiency in macro-analysis and macro-photography	2	2	
	c7	Demonstrate an understanding of liquid penetrant, radiographic and magnetic inspection	2	2	
D		Demonstrate Knowledge of Standards Applied to Materials	2	2	2
	d1	Explain the types of materials testing standards promulgated by ASTM International	2	1	1
	d2	Compare American and European standards, e.g. ASTM and ISO	2	2	1
	d3	Discuss the types of materials testing standards developed by SAE International	3	2	1
	d4	Explain the types of materials testing standards developed by API for oils	3	2	1
	d5	Identify materials by their trade names	2	2	1
E		Perform Appropriate Tests on Metallic Materials	2	1	2
	e1	Perform tensile and compressive tests on metallic materials	2	1	2
	e2	Perform hardness tests on metals	2	1	2
	e3	Perform torsion, impact and creep experiments on metals	2	1	2
	e4	Evaluate the effects of heat treatment and annealing on the properties of metals	2	2	2
F		Perform Appropriate Tests on Polymers and Composites	3	2	2
	f1	Perform tests for stress, strain and impact resistance for plastics	3	2	2
	f2	Perform tests for stress, strain and impact resistance for composite materials	3	2	2
	f3	Perform torsion and creep tests of plastic materials	3	2	2
	f4	Evaluate the effects of temperature on the mechanical properties of plastics	3	2	2
	f5	Evaluate the influence of moisture absorption on the properties of plastics and composites	3	2	2
	f6	Perform tests to evaluate the effects of solvents and acids on polymers and plastics	3	2	2
G		Perform Appropriate Tests on Wood and Concrete (Have knowledge and awareness)	3	2	2
	g1	Perform compression tests on a brittle material such as concrete (aware of tests needed)	3	2	2
	g2	Perform bending and shear strength tests on wood (aware of tests needed)	3	2	2

H		Perform Appropriate Tests of Liquids	3	2	1
	h1	Perform viscosity tests for liquids from low to high viscosity, including liquid polymers	3	2	1
	h3	Perform tests of hydraulic fluids and lubricating oils according to SAE standards	3	2	1
9		MATERIALS AND PROCESSES--METALS	G	M	Marine
A		Define and Describe Constituents, Properties and Processing of Steel	2	1	1
	a1	Describe the primary constituents of steel	2	1	1
	a2	Explain the influence of carbon content on the properties of steel	2	1	1
	a3	Describe the range of carbon content for low, medium and high carbon steel	2	1	1
	a4	Describe how the properties of steel are affected by heat treatments	2	1	1
	a5	Describe quenching and tempering processes for steels	2	1	1
	a6	Define stainless steel	2	1	1
	a7	Differentiate between annealing and heat treating of steels	2	1	1
	a8	Define hardenability of steel	2	1	1
	a9	Explain the process and properties related to case hardening of steel	2	1	1
	a10	Identify the nominal value of the modulus of elasticity of steel	2	1	1
	a11	Demonstrate the basic structure of the iron-carbon phase diagram	2	1	1
	a12	Explain the AISI 4-digit designation system for steel alloys	2	1	1
	a13	Describe the effects of hydrogen embrittlement in steels	2	1	1
	a14	Describe the magnetic properties of carbon steels vs. stainless steel	2	2	2
B		Define and Describe Types and Properties of Cast Irons	3	2	1
	b1	Explain how cast irons differ from steel in terms of composition and properties	2	2	1
	b2	Describe types of cast iron and their uses	3	2	1
C		Identify Types, Properties and Processing of Aluminum and Aluminum Alloys	3	2	1
	c1	Identify common types of aluminum alloys and their principal alloying elements	3	1	1
	c2	Identify the nominal value of the module of elasticity of aluminum	3	2	1
	c3	Demonstrate the 4-digit designation system for aluminum alloys	3	2	1
	c4	Identify common tempers in which aluminum alloys are produced	3	2	1
	c5	Describe work hardening and annealing processes in aluminum and the resulting properties	3	2	1
	c6	Describe anodizing and cladding techniques for aluminum and their influence on properties	3	2	1
D		Discuss Types and Advantages of Copper and its Alloys	3	2	1
	d1	Describe major advantages for using copper and copper alloys in applications	3	2	1
	d2	Identify major types of copper alloys, their major constituents, uses and applications	3	2	1
E		Explain Common Uses for Zinc and its Alloys	3	2	1
	e1	Describe applications for zinc and zinc alloys	3	2	2
F		Identify Properties and Uses of Magnesium and its Alloys	2	2	1
	f1	Describe flammability dangers of magnesium	2	2	1
	f2	Identify common uses for magnesium and its alloys	3	2	1
G		Discuss Advantages of Nickel Alloys and their Uses	3	2	1

	g1	Describe the advantages of nickel alloys as compared to common steel	3	2	1
	g2	Identify types of nickel alloys and their primary alloying ingredients	3	2	1
	g3	Describe Invar and its uses	3	2	1
H		Identify Uses and Processing of Titanium and its Alloys	2	2	1
	h1	Identify common uses for titanium and its alloys	2	2	1
	h2	Describe the basic types of heat treatment used for titanium alloys	2	2	1
10		MATERIALS AND PROCESSING--PLASTICS	G	M	Marine
A		Identify Properties and Applications of Thermoplastic Materials	3	2	1
	a1	Describe the general nature of thermoplastics	2	1	1
	a2	Identify major advantages and disadvantages of thermoplastics as compared to metals	2	2	1
	a3	Describe common filler materials used in thermoplastics and their effect on properties	2	2	11
	a4	Discuss the effect of increased temperature on the properties of thermoplastics	2	2	1
	a5	Identify and describe common methods for processing thermoplastics	3	2	1
	a6	Define creep in thermoplastics and how it is measured	3	2	1
	a7	Discuss the effects of moisture absorption on the properties of thermoplastics	3	2	1
	a8	Identify common types of thermoplastics and describe common uses	3	2	1
	a9	Describe and compare amorphous and crystalline thermoplastics	3	2	1
B		Identify Properties and Applications of Thermoset Plastics	3	2	1
	b1	Describe the general nature of thermoset plastics as compared to thermoplastics	2	1	1
	b2	Identify major types of thermoset plastics and their common uses	3	2	1
	b3	Describe the general nature of fiber reinforced plastics (FRP)	2	2	1
	b4	Identify types of glass fiber used in FRP	3	2	1
	b5	Describe the curing stages of thermoset plastics (ABC stages)	3	2	1
	b6	Describe solid surface thermoset plastics, e.g. Corian™	3	3	1
11		MATERIALS AND PROCESSING--COMPOSITES			
A		Describe the Structure and Advantages of Composite Materials	2	2	1
	a1	Describe a composite material	2	1	1
	a2	Discuss advantages and disadvantages to composites vs. metals	2	1	1
	a3	Identify common materials used for the matrix of composite materials	2	1	1
	a4	Identify typical materials used for the fiber component of fiber composites	2	2	1
	a5	Describe the terminology used for types of composites, e.g. ply, laminate, particle reinforced	2	2	1
	a6	Describe honeycomb and other core materials for composites	3	2	1
	a7	Explain unidirectional and quasi-isotropic structure of composites	3	2	1
	a8	Describe applications of composites for replacing metals, plastics, concrete, and wood	3	2	1
B		Explain Basic Processing Procedures for Composite Materials	3	2	1
	b1	Describe proper storage temperatures and conditions for composites and their components	2	2	1
	b2	Explain proper curing processes for composites	2	2	2
	b3	Explain the use of thermocouples in composite curing and their placements	2	2	1
	b4	Demonstrate proper tool preparation for composite fabrication	2	2	1
	b5	Describe the different lay-up tools and techniques and the effects of thermal expansion	2	2	1
	b6	Describe weaving procedures to produce fabrics from fibers for composite	3	2	11

		lay-up			
	b7	Describe the handling of composite materials and the importance of <i>out time</i> logs	3	2	1
	b8	Identify resin rich and resin starvation conditions and their causes composites	3	2	1
	b9	Describe proper bagging sequences and bagging materials for composite lay-up	3	2	1
	b10	Explain the term <i>hot debulk</i> applied to composite lay-up	3	2	1
	b11	Describe basic design, operation and function of autoclaves used in composite fabrication	3	3	3
12		MATERIALS AND PROCESSING--WOOD			
A		Describe the Properties and Testing Processes for Wood (For pleasure craft)	3	2	1
	a1	Describe the differences between wood and metals as they effect properties	3	2	1
	a2	Explain primary testing procedures for wood and how they differ from metals or composites	3	2	1
	a3	Identify species of wood used for specific applications	3	2	1
13		MATERIALS AND PROCESSING--CONCRETE			
A		Describe Constituents and Testing Procedures for Concrete	3	2	3
	a1	Describe differences between concrete and metals or composites as they effect properties	3	2	3
	a2	Describe the primary testing procedures for concrete that differ from metals or composites	3	2	3
	a3	describe the components of concrete and how it is made	3	2	2
14		MATERIALS AND PROCESSING--GLASSES	G	M	Marine
A		Describe Structure, Properties and Behavior of Glass	3	2	2
	a1	Explain the molecular structure of glass and contrast it to metals	3	2	2
	a2	Describe property differences between glass and metals or composites	3	2	2
	a3	Describe testing methods for glassy materials	3	2	2
	a4	Explain why annealing of glass is important for properties	3	2	2
	a5	Describe thermal conductivity and thermal expansion of glasses and how they affect properties	3	2	2
	a6	Describe the parameters of glasses used in thermal shock resistant applications	3	2	2
	a7	Explain why glasses are stronger in compression than in tension	3	2	2
	a8	Describe the electrical properties of glass and its use in applications	3	2	2
	a9	Describe viscosity-related parameters for glass, including softening point, working range	3	2	2
	a10	Identify glass transition temperature and melting temperature of typical glasses	3	3	3
15		MATERIALS AND PROCESSING--CERAMICS (Awareness of)			
A		Describe Structure, Properties and Processing of Ceramics	3	2	2
	a1	Explain the structure and properties of ceramic materials and how they differ from other materials	2	2	2
	a2	Describe primary testing techniques for ceramics	3	2	2
	a3	Explain the difference between glass ceramics and other ceramics	3	2	2
	a4	Describe thermal expansion and thermal shock behavior of ceramics	3	3	3

	a5	Describe electrical properties of ceramics and their applications	3	3	3
	a6	Explain the brittle behavior of ceramics	3	3	3
16		RELATIONSHIP BETWEEN PROCESSING VARIABLES, QUALITY, DEFECTS AND PROPERTIES			
A		Explain Effects of Processing and Manufacturing Variables on Material Properties	1	1	1
	a1	Explain the effects of operator, machine or material error on material properties and products	1	1	1
	a2	Describe how changes in manufacturing processes affect material properties	1	1	1
	a3	Explain how cold working affects the mechanical properties of metals	2	1	1
	a4	Describe how heat treating and annealing affect the structural properties of metals	2	1	1
B		Describe the Effects of Defects on Material Properties	2	1	1
	b1	Explain how defects such a nicks and scratches affect properties of metals and alloys	2	1	1
	b2	Describe how defects in surface preparation affect properties of plastics and polymers	2	1	1
	b3	Explain the effects that defects in processing and surface preparation on composite properties	2	2	1
	b4	Describe how defects can affect properties of ceramic materials	2	2	2
			G	M	Marine
17		FABRICATION AND PROCESSING OF MATERIALS			
A		Explain General Means for Processing Materials	2	2	2
	a1	Explain methods for finishing material for appearance and corrosion resistance	2	1	1
	a2	Describe available types of mechanical fastening methods	2	1	1
	a3	Describe use of adhesives for fastening materials, along with needed surface preparation	2	2	1
	a4	Explain the importance of pre-loading during fabrication and assembly	2	2	1
	a5	Describe the basic requirements for the application of 2-part adhesives	2	2	1
	a6	Explain where moisture-cure adhesives should be utilized	3	2	1
	a7	Describe techniques for using shims and where and when this is appropriate	2	2	1
B		Describe Techniques Used in Metals Processing	2	1	1
	b1	Describe methods used for forming, casting and molding metals	2	1	1
	b2	Explain how surface finishes of machined metals affect properties	2	1	1
	b3	Describe the basic types of joining processes for metals, e.g. welding, brazing, soldering, etc.	2	1	1
	b4	Describe the primary means for machining metals	2	1	1
	b5	Explain how soldering is used for metal fabrication	2	2	2
	b6	Describe shot peening and roto-peening and how to adjust the process for metal products	2	2	2
C		Explain Methods for Processing Plastics and Composites	2	2	2
	c1	Describe methods available for forming, molding and curing plastics	2	1	1
	c2	Explain the basic types of joining processes for plastics and composites	2	2	1
	c3	Discuss methods used for the formation of composite materials and structures	2	2	1
18		TOOLING, DIES, JIGS AND FIXTURES USED IN MATERIALS PROCESSING	G	M	Marine

A		Describe General Tooling Practices	2	2	2
	a1	Explain a <i>hard coordinate</i> in tooling	2	2	2
	a2	Describe a theodolite and a laser tracker and their uses in measurement	2	2	3
B		Explain Use of Dies and Jigs used for Metal Processing	2	2	1
	b1	Describe types of cutting tools used to machine metals (per craft)	1	2	1
	b2	Describe grinding tools used with metals and their use	2	2	1
	b3	Describe dies used with metal extrusion or casting	2	2	1
	b4	Explain the types of jigs and fixtures used in processing metallic parts (special tools)	2	2	1
	b5	Describe dies used in forming and forging metals	2	2	1
C		Explain Use of Tooling in Plastics and Composite Materials Processing	2	2	1
	c1	Describe dies used in extruding and molding plastics	2	2	1
		Explain tools used for cutting composites and how they are used	2	2	1
		Describe the fabrication of molds for composite processing: materials, splash, soft tooling	2	2	1
19		MANUFACTURING OPERATIONS AND QUALITY MANAGEMENT			
A		Demonstrate Processes to Promote Quality Management Practices	2	1	1
	a1	Recognize and address quality and safety issues	1	1	1
	a2	Differentiate between critical and non-critical defects	2	1	1
	a3	Explain the concept of internal and external customer--their wants and needs	2	1	1
	a4	Describe the costs of poor quality parts	2	2	1
	a5	Demonstrate understanding of quality management systems used in industry	2	2	1
	a6	Explain the use of six sigma tools and their use in industry	2	2	1
B		Apply Statistical, Cost, Lifecycle and Related Management Principles to Manufacturing Processes and Management	2	2	2
	b1	Apply statistics to process control (SPC)	2	2	2
	b2	Determine the cost of manufacturing a product or component	2	2	2
	b3	Explain lean manufacturing tools and practices, as used in industry	2	2	2
	b4	Demonstrate a basic understanding of business economics	2	2	2
	b5	Explain the fundamentals of risk management	2	2	2
	b6	Demonstrate use of enterprise resource planning (ERP) software	3	2	2
	b7	Demonstrate knowledge of workforce control	2	2	2
	b8	Describe the fundamentals of product life cycle management	2	2	2
	b9	Demonstrate understanding of basic product assembly techniques	2	2	2
	b10	Describe the fundamentals of supply chain management	2	3	3
	b11	Demonstrate knowledge of large scale system integration	2	3	3
	b12	Use effectively manufacturing simulation software	2	3	3