

NATIONAL RESOURCE CENTER FOR MATERIALS TECHNOLOGY EDUCATION
Core Competency Study for Technicians who use Materials in their Work
 Competency Importance for General (G) and Materials (M) Technicians
 Update February 2009

		Classification System:	Importance Rating Scale:	General Tech G	Materials Tech M
		19 Categories 0, 1, 2, etc.	1 = vital		
		75 Competency Concentrations A, B, C, etc.	2 = impor		
		386 Performance indicators a1, a2, a3, etc.	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
A	Demonstrate Good Communication Skills			1	1
	a1	Demonstrate ability to listen and comprehend instructions		1	1
	a2	Demonstrate ability to read and comprehend English		1	1
	a3	Interpret specific instructions from supervisor		1	1
	a4	Demonstrate ability to write clear letters, instructions, reports		2	1
	a5	Use e-mail, FAX and other electronic means of communication		2	2
	a6	Communicate non-documented process to fellow employees or supervisors		2	2
	a7	Read non-English information such as materials specifications		3	2
B	Prepare Tests and Analyze Data			1	1
	b1	Prepare tests and record test details and data neatly and accurately		1	1
	b2	Demonstrate good lab notebook skills		1	1
	b3	Analyze test data, compare and contrast information, draw rational conclusions		2	1
C	Demonstrate Good Workplace Performance Methods			1	1
	c1	Demonstrate good workplace safety methods		1	1
	c2	Recall company practices on timeliness, attendance, punctuality, diversity, confidentiality		1	1
	c3	Practice good time management and housekeeping skills		1	1
	c4	Work effectively in teams within the workforce or group		1	1
	c5	Demonstrate flexibility, willingness to learn and ability to solve problems		1	1
	c6	Recognize what needs to be done to solve a problem and take steps to accomplish it		1	1
	c7	Exercise independent judgment and willingness to assume responsibility		2	1
	c8	Apply problem solving methods and continuous improvement techniques		2	2
	c9	Perform job functions demanding manual dexterity, dynamic and explosive strength		2	2
	c10	Effectively break out non-documented tasks into a series of tasks or activities		2	2
D	Demonstrate General Technical Competence			1	1
	d1	Recall key job-related information (processes, references, terminology, acronyms)		1	1
	d2	Show good observations skills during demonstrations of processes or equipment operation		1	1
	d3	Perform troubleshooting of equipment and instrumentation		1	1
	d4	Perform basic setup, diagnosis and repair of industrial machinery and equipment		1	1
	d5	Use vendor catalogs to acquire materials and components for work tasks		2	2
	d6	Identify the need and process for the removal of hazardous materials (RoHM)		2	2
1	MEASUREMENT AND BASIC TECHNICAL SKILLS				
A	Carry Out Measurements of Dimensions and of Physical Phenomena			1	1
	a1	Measure accurately hardness, impact strength and related properties of materials		2	1
	a2	Measure accurately tensile, compressive and shear properties of materials		2	1
	a3	Measure accurately dimensions using scales, micrometers and related tools		1	1
	a4	Demonstrate knowledge of order of magnitude of measurements and scales		1	1
	a5	Measure accurately temperature, pressure, force, torque and related quantities		1	1
	a6	Perform tests of physical properties such as density, viscosity, pH, etc.		2	1
	a7	Use correct terms for weight, mass and density in technical tasks		1	1
	a8	Measure accurately mass using appropriate devices		2	1
	a9	Perform calibration of instruments and describe the importance of proper calibration		1	1
	a10	Describe the difference between precision and accuracy		2	1
	a11	Apply precision metrology devices and inspection tools		2	2
	a12	Describe and apply effectively a variety of types of thermocouples		2	2
	a13	Use and apply vapor pressure data for water, solvents and other liquids		3	3
B	Interpret Technical Drawings			2	2
	b1	Read and interpret technical drawings		1	1
	b2	Interpret and apply tolerances on component dimensions and specifications		2	2
	b3	Read specifications on non-English technical drawings		3	3

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1		Measurement and Basic Technical Skills, continued	G	M
	C	Demonstrate Laboratory Skills	2	1
	c1	Demonstrate familiarity with good laboratory practice	1	1
	c2	Use a microscope for measurement and observation of material structures	2	1
	c3	Operate a digital camera to obtain high quality images of technical objects	2	1
	c4	Select appropriate devices and instruments for measurement of physical phenomena	2	1
	c5	Operate successfully basic shop machinery and tools	1	2
	c6	Operate air and gas flow systems and pressure and flow regulators	2	2
	c7	Operate vacuum equipment and read vacuum data in appropriate units	2	2
	c8	Practice good operating methods in clean rooms	2	2
	D	Apply Electrical Phenomena to Physical Measurements	2	2
	d1	Use a digital millimeter for measurement of resistance, current, voltage and continuity	2	2
	d2	Use sensors for measurement of physical phenomena	2	2
	d3	Measure electrical conductivity and other electrical properties of materials	2	2
	d4	Apply principles of electricity and electronics to measurement and equipment operations	2	2
	d5	Perform successfully soldering operations for electrical connections	2	2
	d6	Analyze and apply basic DC and AC circuits	2	2
	d7	Demonstrate proper use of the electrical relationship $V = IR$	2	2
	d8	Perform electrical circuit bread boarding	3	2
2		MATHEMATICS, CALCULATIONS AND DATA SYSTEMS		
	A	Apply Basic Mathematics Fundamentals	1	1
	a1	Demonstrate mastery of basic arithmetic, including proportions, percentages, etc	1	1
	a2	Show that data, calculations and results are reasonable	1	1
	a3	Use mental arithmetic and calculators as computation tools	1	1
	a4	Prepare and interpret graphs using a variety of scales and presentation techniques	2	1
	B	Demonstrate Proper Use of Units and Conversions	1	1
	b1	Manipulate and report accurately units for all calculations	1	1
	b2	Perform conversion of units from one systems to another	1	1
	b3	Demonstrate use of significant figures, accuracy and precision	1	1
	b4	Use accurately both U.S. customary units and the International System of Units (ISU)	2	1
	C	Apply Geometry and Trigonometric Functions	2	2
	c1	Utilize concepts of perimeter, area and volume of basic shapes	1	1
	c2	Apply concepts of angles and triangles	2	2
	c3	Demonstrate concepts of trigonometry, including sine, cosine, tangent and related functions	2	2
	D	Demonstrate Appropriate Use of Algebra and Functions	2	2
	d1	Apply concepts of algebra to solve equations for desired results	2	2
	d2	Demonstrate proper use of slope and rate of change	2	2
	d3	Analyze functions such as linear, exponential, quadratic, polynomial and logarithmic	2	2
	d4	Work effectively with inequalities	3	2
	E	Demonstrate Appropriate Use of Statistics	2	2
	e1	Compute the mean, median and standard deviation of data sets	2	1
	e2	Apply the fundamentals of statistics and probability	2	2
	e3	Make inferences based on data analysis and measurements of variability	2	2
	e4	Apply concepts of the normal curve	2	2
3		COMPUTER SKILLS		
	A	Practice Appropriate Computer Skills and Uses	1	1
	a1	Exercise understanding of inappropriate usages of computer systems	1	1
	a2	Demonstrate adherence to computer security policies	1	1
	a3	Demonstrate good keyboard skills	1	1
	a4	Use e mail and text messaging effectively and with good grammar and spelling	2	1
	B	Demonstrate Use of Computer Applications	2	1
	b1	Create and use spreadsheets for data analysis, graphing, record keeping and other uses	2	1
	b2	Use the internet effectively for researching and acquiring technical information	2	1
	b3	Create quality written documents using word processing	2	1

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3		Computer Skills, continued	G	M
	B	Demonstrate Use of Computer Applications, continued	2	1
	b4	Create and use database applications	2	1
	b5	Integrate documents containing word processing, spreadsheets and graphics	2	2
	C	Apply Technical Software to Practice	2	2
	c1	Use commercially available software for analysis, data acquisition and similar tasks	2	2
	c2	Create and modify technical drawings using computer aided design, including 3D modeling	2	2
	c3	Demonstrate use of computational software such as Matlab, MathCAD, etc	3	2
	4	Teamwork, Professionalism, Globalism and Multicultural Skills		
	A	Demonstrate Effective Work With Teams	1	1
	a1	Work productively in an industrial team environment	1	1
	a2	Demonstrate understanding of the behavior of successful teams	1	2
	a3	Manage conflict effectively and with sensitivity o the needs and perceptions of others	1	1
	B	Determine and Develop Effective Project Interactions	2	2
	b1	Plan and track work flow using the principles of project management	2	2
	b2	Describe the functions of various departments commonly found in industry	2	2
	b3	Plan effective agendas for meetings	2	2
	b4	Conduct effective meetings	3	2
	C	Show Personal Professionalism	1	1
	c1	Manage time efficiently	1	1
	c2	Demonstrate adherence to the human resource policies of the employer	1	1
	c3	Practice proper personal hygiene	1	1
	c4	Effectively adopt and adapt skills and knowledge acquired during training	1	1
	c5	Display the personal and ethical characteristics necessary to be identified as a professional	1	1
	c6	Describe the practice the basic principles of intellectual property protections	2	2
	c7	Demonstrate life-long learning and plan and track personal professional growth	2	2
	c8	Demonstrate good presentation skills for small groups and larger audiences	2	2
	D	Demonstrate Cultural Awareness in the Workplace	2	2
	d1	Demonstrate awareness of cultural differences to facilitate effective communication among	2	2
	d2	Apply a basic understanding of human behavior in dealing with workplace issues	2	2
	E	Recognize Where a Global Perspective Should Be Used in the Workplace	2	2
	e1	Demonstrate basic knowledge of the global economic system	2	2
	e2	Demonstrate basic understanding of global economic trends	2	2
	e3	Identify key elements of import and export strategies and global trade issues	3	3
	5	CHEMICAL SCIENCE SKILLS		
	A	Apply Safe and Environmentally Appropriate Methods to Chemical Handling	1	1
	a1	Demonstrate safe handling of acids, bases, flammable liquids, cryogenic fluids and compr. g	1	1
	a2	Apply safely the information available in Material Safety Data Sheets	1	1
	a3	Apply knowledge of chemical and environmental safety including waste disposal and recycling	1	1
	a4	Define flammability hazards of solvents such as flash point and explosive potential	2	1
	a5	Demonstrate understanding of the interactions of science and technology with society	2	2
	B	Demonstrate Knowledge of Chemistry Fundamentals	2	1
	b1	Read basic chemical compound abbreviations, e.g.HCl as hydrochloric acid	2	1
	b2	Demonstrate knowledge of chemical symbols and the periodic table of the elements	2	1
	b3	Demonstrate understanding of chemical concentrations and what they mean	2	1
	b4	Explain the importance of material compatibility	2	1
	b5	Apply the scientific method in a laboratory and in a variety of technical situations	2	1
	b6	Describe the fundamental nature of liquids, solids and gasses	2	1
	b7	Describe and compare the nature of organic and inorganic chemicals	2	2
	b8	Prepare an etching solution	3	2
	b9	Demonstrate knowledge of corrosion potential, chemical batteries and galvanic series	3	2
	b10	Describe the chain structure of polymers	3	3

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5		Chemical Science Skills, continued	G	M
	C	Describe Atomic and Nuclear Structure and Radioactive Decay	3	2
	c1	Describe the basic characteristics of electrons, neutrons and protons in atomic structure	3	2
	c2	Describe the characteristics of radioactive decay	3	3
6		PHYSICAL SCIENCE SKILLS		
	A	Apply Basic Concepts of Mechanics	2	2
	a1	Apply correctly appropriate units for physical quantities	2	1
	a2	Use correctly the concepts of weight and mass	2	1
	a3	Apply principles of force, moments and static equilibrium	2	2
	a4	Explain the principles of the concept of frictions	2	2
	a5	Demonstrate and apply Newton's law $F = ma$	2	2
	a6	Apply fundamentals of potential and kinetic energy and of conservation of motion	2	2
	a7	Apply fundamentals of motion: velocity, acceleration, momentum, including rotational motion	2	2
	a8	Explain the concept of inertia and its relationship to acceleration and other forces	2	2
	B	Apply Concepts of Fluids, Heat and Thermal Conduction	2	2
	b1	Apply concepts of heat, including temperature, thermal conductivity, specific heat, etc.	2	1
	b2	Use concepts of thermal expansion and differential thermal expansion	2	2
	b3	Demonstrate concepts of fluid pressure and behavior of fluids in annealing and heat treating	3	2
	C	Describe and Apply Concepts of Electricity and Magnetism	2	2
	c1	Describe concepts of electromagnetic waves: x-rays, UV, radio waves and visible light	2	2
	c2	Explain the electrical properties of conductors, insulators and semiconductors	2	2
	c3	Apply concepts of magnetism and its role in motors and other phenomena	2	2
	D	Apply Concepts of Light and Sound	2	2
	d1	Apply concepts of light and optics as applied to physical measurements	2	2
	d2	Demonstrate concepts of sound measurement and control	2	2
7		FUNDAMENTALS OF MATERIALS SCIENCE AND ENGINEERING		
	A	Identify the General Nature of Metals	2	1
	a1	Recognize the general nature and available types of non-ferrous metals	2	1
	a2	Describe the general nature of ferrous metals	2	1
	a3	Explain what can be learned about a metal alloy from its phase diagram	2	1
	a4	Discuss the general nature of magnetic materials	2	2
	B	Discuss the General Nature of Plastics and Polymers	2	1
	b1	Explain the general behavior of thermoplastic materials	2	1
	b2	Describe the general behavior of thermoset plastics	2	1
	b3	Recognize the differences between plastics and elastomers	2	2
	C	Describe the General Nature of Composite Materials	2	2
	c1	Discuss the general nature of fiber-reinforced composites	2	2
	c2	Describe the nature of structural foam composite materials	2	2
	c3	Recognize other types of composites and how they differ from one-another	2	2
	D	Identify the General Nature of Semiconductors and Optical Materials	3	2
	d1	Describe the nature of semiconductors and other materials used in electronic devices	3	2
	d2	Describe the nature of optical materials used in optics and in displays	3	2
	d3	Explain the structure and properties of optical fibers	3	2
	E	Describe the General Nature and Behavior of Ceramics and Glasses	2	2
	e1	Discuss the general nature and properties of ceramic materials	2	2
	e2	Explain the general behavior of glasses	2	2
	F	Identify the General Nature and Properties of Other Materials used in Engineering	3	2
	f1	Describe the nature of wood and its derivatives	3	2
	f2	Explain the general nature of concrete	3	2

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10		MATERIALS AND PROCESSING--PLASTICS	G	M
	A	Identify Properties and Applications of Thermoplastic Materials	3	2
	a1	Describe the general nature of thermoplastics	2	1
	a2	Identify major advantages and disadvantages of thermoplastics as compared to metals	2	2
	a3	Describe common filler materials used in thermoplastics and their effect on properties	2	2
	a4	Discuss the effect of increased temperature on the properties of thermoplastics	2	2
	a5	Identify and describe common methods for processing thermoplastics	3	2
	a6	Define creep in thermoplastics and how it is measured	3	2
	a7	Discuss the effects of moisture absorption on the properties of thermoplastics	3	2
	a8	Identify common types of thermoplastics and describe common uses	3	2
	a9	Describe and compare amorphous and crystalline thermoplastics	3	2
	B	Identify Properties and Applications of Thermoset Plastics	3	2
	b1	Describe the general nature of thermoset plastics as compared to thermoplastics	2	1
	b2	Identify major types of thermoset plastics and their common uses	3	2
	b3	Describe the general nature of fiber reinforced plastics (FRP)	2	2
	b4	Identify types of glass fiber used in FRP	3	2
	b5	Describe the curing stages of thermoset plastics (ABC stages)	3	2
	b6	Describe solid surface thermoset plastics, e.g. Corian™	3	3
11		MATERIALS AND PROCESSING--COMPOSITES		
	A	Describe the Structure and Advantages of Composite Materials	2	2
	a1	Describe a composite material	2	1
	a2	Discuss advantages and disadvantages to composites vs. metals	2	1
	a3	Identify common materials used for the matrix of composite materials	2	1
	a4	Identify typical materials used for the fiber component of fiber composites	2	2
	a5	Describe the terminology used for types of composites, e.g. ply, laminate, particle reinforce	2	2
	a6	Describe honeycomb and other core materials for composites	3	2
	a7	Explain unidirectional and quasi-isotropic structure of composites	3	2
	a8	Describe applications of composites for replacing metals, plastics, concrete, and wood	3	2
	B	Explain Basic Processing Procedures for Composite Materials	3	2
	b1	Describe proper storage temperatures and conditions for composites and their components	2	2
	b2	Explain proper curing processes for composites	2	2
	b3	Explain the use of thermocouples in composite curing and their placements	2	2
	b4	Demonstrate proper tool preparation for composite fabrication	2	2
	b5	Describe the different lay-up tools and techniques and the effects of thermal expansion	2	2
	b6	Describe weaving procedures to produce fabrics from fibers for composite lay-up	3	2
	b7	Describe the handling of composite materials and the importance of <i>out time</i> logs	3	2
	b8	Identify resin rich and resin starvation conditions and their causes in composites	3	2
	b9	Describe proper bagging sequences and bagging materials for composite lay-up	3	2
	b10	Explain the term <i>hot debulk</i> applied to composite lay-up	3	2
	b11	Describe basic design, operation and function of autoclaves used in composite fabrication	3	3
12		MATERIALS AND PROCESSING--WOOD		
	A	Describe the Properties and Testing Processes for Wood	3	2
	a1	Describe the differences between wood and metals as they effect properties	3	2
	a2	Explain primary testing procedures for wood and how they differ from metals or composites	3	2
	a3	Identify species of wood used for specific applications	3	2
13		MATERIALS AND PROCESSING--CONCRETE		
	A	Describe Constituents and Testing Procedures for Concrete	3	2
	a1	Describe differences between concrete and metals or composites as they effect properties	3	2
	a2	Describe the primary testing procedures for concrete that differ from metals or composites	3	2
	a3	describe the components fo concrete and how it is made	3	2

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14		MATERIALS AND PROCESSING--GLASSES	G	M
A		Describe Structure, Properties and Behavior of Glass	3	2
	a1	Explain the molecular structure of glass and contrast it to metals	3	2
	a2	Describe property differences between glass and metals or composites	3	2
	a3	Describe testing methods for glassy materials	3	2
	a4	Explain why annealing of glass is important for properties	3	2
	a5	Describe thermal conductivity and thermal expansion of glasses and how they effect proper	3	2
	a6	Describe the parameters of glasses used in thermal shock resistant applications	3	2
	a7	Explain why glasses are stronger in compression than in tension	3	2
	a8	Describe the electrical properties of glass and its use in applications	3	2
	a9	Describe viscosity-related parameters for glass, including softening point, working range	3	2
	a10	Identify glass transition temperature and melting temperature of typical glasses	3	3
15		MATERIALS AND PROCESSING--CERAMICS		
A		Describe Structure, Properties and Processing of Ceramics	3	2
	a1	Explain the structure and properties of ceramic materials and how they differ from other ma	2	2
	a2	Describe primary testing techniques for ceramics	3	2
	a3	Explain the difference between glass ceramics and other ceramics	3	2
	a4	Describe thermal expansion and thermal shock behavior of ceramics	3	3
	a5	Describe electrical properties of ceramics and their applications	3	3
	a6	Explain the brittle behavior of ceramics	3	3
16		RELATIONSHIP BETWEEN PROCESSING VARIABLES, QUALITY, DEFECTS AND PROPERTIES		
A		Explain Effects of Processing and Manufacturing Variables on Material Properties	1	1
	a1	Explain the effects of operator, machine or material error on material properties and produc	1	1
	a2	Describe how changes in manufacturing processes affect material properties	1	1
	a3	Explain how cold working affects the mechanical properties of metals	2	1
	a4	Describe how heat treating and annealing affect the structural properties of metals	2	1
B		Describe the Effects of Defects on Material Properties	2	1
	b1	Explain how defects such a nicks and scratches affect properties of metals and alloys	2	1
	b2	Describe how defects in surface preparation affect properties of plastics and polymers	2	1
	b3	Explain the effects that defects in processing and surface preparation on composite propert	2	2
	b4	Describe how defects can affect properties of ceramic materials	2	2
17		FABRICATION AND PROCESSING OF MATERIALS		
A		Explain General Means for Processing Materials	2	2
	a1	Explain methods for finishing material for appearance and corrosion resistance	2	1
	a2	Describe available types of mechanical fastening methods	2	1
	a3	Describe use of adhesives for fastening materials, along with needed surface preparation	2	2
	a4	Explain the importance of pre-loading during fabrication and assembly	2	2
	a5	Describe the basic requirements for the application of 2-part adhesives	2	2
	a6	Explain where moisture-cure adhesives should be utilized	3	2
	a7	Describe techniques for using shims and where and when this is appropriate	2	2
B		Describe Techniques Used in Metals Processing	2	1
	b1	Describe methods used for forming, casting and molding metals	2	1
	b2	Explain how surface finishes of machined metals affect properties	2	1
	b3	Describe the basic types of joining processes for metals, e.g. welding, brazing, soldering, et	2	1
	b4	Describe the primary means for machining metals	2	1
	b5	Explain how soldering is used for metal fabrication	2	2
	b6	Describe shot peening and roto-peening and how to adjust the process for metal products	2	2
C		Explain Methods for Processing Plastics and Composites	2	2
	c1	Describe methods available for forming, molding and curing plastics	2	1
	c2	Explain the basic types of joining processes for plastics and composites	2	2
	c3	Discuss methods used for the formation of composite materials and structures	2	2

