

Aerospace SME Composites Technician Focus Group Correlation

Purpose of the Focus Group: The purpose of the aerospace composite technician focus group was to bring together subject-matter-experts from the aerospace composites industry to help us in the instructional design process by analyzing industry specific tasks and the knowledge and skills needed to perform the tasks. The analysis helped us validate, revise, and identify performance task, knowledge, skills, and attributes needed by graduates of the certificate program. Starting with relevant outcomes, we were able to identify performance learning objectives, performance indicators, and learning activities for the aerospace composites certificate program.

Focus Group Participants: The focus group participants were aerospace and aviation industry composites technicians that are considered by their peers and managers to be high performers as well as subject-matter-experts that currently work as first level supervisors of composites technicians. The purpose for these demographics was to ensure that the participants possessed detailed knowledge of the needed knowledge, skills, and attributes demonstrated by successful composites technicians.

Navigating the Aerospace Subject Matter Expert Technician Focus Group Correlation Report: The findings from three focus groups were correlated and the data is formatted in six columns under instructional topic areas. The first three columns represented technician task for each of the three focus groups (Everett/Edmonds, Cerritos, and St. Louis), and the last three columns represent knowledge-skills-attitudes needed to perform the tasks for each of the three focus groups (Everett/Edmonds, Cerritos, and St. Louis). Column 1 list task from the Everett/Edmonds focus group links to column 4 list the knowledge-skills-attitudes (KSA) from the Everett/Edmonds focus group. Likewise, column 2 task from the Cerritos area focus group links to column 5 KSA Cerritos area focus group and column 3 task from the St. Louis area focus group links to column 6 KSA St. Louis area focus group.

As shown in the example below, the shaded areas represent no related data from a specific focus group.

Everett Task 3-26-07	Cerritos Task 4-27-07	StLouis Task 5-17-07	Everett KSA 3-26-07	Cerritos KSA 4-27-07	StLouis KSA 5-17-07
Example of the Focus Group Correlation Report Format					
Everett area task curriculum.	Cerritos area task that is similar to the Everett area task	No related task to Everett or Cerritos area task	Everett area KSA that links to task in first column	Cerritos area task that links to second column	No related KSA to Everett or Cerritos area task

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Instructional Topic Area: Advanced Manufacturing Materials (Core Course)					
No task listed but felt knowledge of the industry should be covered in curriculum.	Opportunities in the composites industry		Knowledge of the composites industry and applications	Knowledge of the composites industry and applications Recognize potential allergic reactions some people have to composites and chemicals/know history of composites industry	
Recognize polymer matrix composites manufacturing materials	Identify and recognize manufacturing materials	Recognize manufacturing materials	Knowledge of materials from a nano and micro scale through basic isotropic performance and processing	Knowledge of polymers and reinforcements used in composites construction compared to metals	Knowledge of materials characteristics. What materials are and how to use them.
Use materials and composites industry terminology	Use materials and composites industry terminology	Use materials and composites industry terminology	Know and understand the key materials and composites industry terms	Know and understand the key materials and composites industry terms	Know and understand the key materials and composites industry terms
		Identify why composites are used in aerospace			Know characteristics of composites verses traditional materials
Identify specific applications for different composite materials	Identify specific applications for different composite materials	Identify specific applications for different composite materials	Knowledge of different types of resins, reinforcements, and	Knowledge of different types of resins, reinforcements, and	Knowledge of different types of resins, reinforcements, and

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			core materials. Know how to follow work orders and specifications. Knowledge of types and purposes of core materials	core materials. Knowledge of thermoset and thermoplastic	core materials
Distinguish between composites and other materials	Distinguish between composites and other materials	Distinguish between composites and other materials	Knowledge of differences between properties composite and other materials	Knowledge of differences between properties composite and other materials	Knowledge of differences between properties composite and other materials
Determine correct polymers and matrices per application	Determine correct materials per specifications	Determine correct materials per specifications	Knowledge of different polymers and their uses. Knowledge of thermosets and thermoplastics	Able to identify correct materials per specifications	Knowledge of the different materials, surface treatments, and their uses
Identify correct fiber per work order specifications.	Identify different fillers per specifications	Determine correct resins and matrices per application (Very small weight to this task)	Knowledge of the different fibers, surface treatments, and their uses	Knowledge of the different fillers and their uses	Knowledge of the different resins and their uses Knowledge of thermoset and thermoplastic
Identify different fillers per specifications			Knowledge of the different fillers and their uses		
	Coupon lay-up	Follow specifications for composite materials for specific environments		Knowledge of the different interfaces and their properties (<i>specifications on hand</i>)	Knowledge of the environmental effects on composite materials
Recognize	Proper storage and		Knowledge of the	Knowledge of the	

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environmental effects on specific composites materials	handling per specifications		environmental effects on composite materials	environmental effects on composite materials. Knowledge of storage and handling—proper removal and log document out time and in time.	
	Select core materials per specifications	Select core materials per specifications		Knowledge of types and purposes of core materials	Knowledge of types and purposes of core materials
Determine proper surface prep (Suggest moving to composites course)	Determine proper tool prep		Knowledge of the different interfaces and their properties (<i>specifications on hand</i>)	Know how to apply release agent and know what to use and how to clean tool.	
		Identify specific applications per adhesive materials			Knowledge of specific adhesives and their applications
Safety —Safely uses chemicals and potentially hazardous substances	Safety —Safely uses chemicals and potentially hazardous substances	Safety —Safely uses and disposes of materials, chemicals, and potentially hazardous substances	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances. Recognize potential allergic reactions some people have to composites and chemicals	Knowledge of types and purposes of core materials	Knowledge of proper handling, use, and disposal of materials, chemicals, and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Safety —Uses MSDS (Material Data Safety Sheets) properly	Safety —Uses MSDS (Material Data Safety Sheets) properly	Knowledge and skills to read and properly follow MSDS	Knowledge of proper handling, use, and disposal of chemicals	Knowledge and skills to read and properly follow MSDS

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				and potentially hazardous raw materials and waste	
Safety —Seeks medical attention if experiencing a personal physical reaction	Safety —Seeks medical attention if experiencing a personal physical reaction	Safety —Seeks medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials	Knowledge and skills to read and properly follow MSDS	Knowledge potential physical reactions to composite materials
	Safety —Identify flammable materials to be stored in flammable storage cabinets			Know how to identify reactions and when to seek medical attention	
	Safety —Ensures identification marking on materials and store chemical compatibly			Able to read NFBA plaque (NFBA = National Fire Protection Agency)	
	Safety —Clean rims and outside of containers prior to storage			Knowledge of how to identify, markings, store, and transport chemicals	
				Know how to clean rims and outside of containers prior to putting caps on and reasons for housekeeping	

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Instructional Topic Area: Enterprise Teaming (Core Course)					
Communicate across culture/international	Communicate across company culture	Communicate and interact across culture	Understand the language and perspectives of different disciplines within and outside the organization.	Understanding of various department roles and functions	Know what others need to know and why they need to know it. Use interpersonal skills at multiple levels
Work as part of a manufacturing team	Work as part of a manufacturing team	Work as part of a manufacturing team	Understand the dynamics and team interaction/communication. Use team participation techniques. Use team conflict resolution techniques. Understands final solution (big picture)	Understand basics of team dynamics	Know and understand RAA to team (REA = responsibility, accountability, authority) Know how to form, storm, norm, and perform
Work with team to problem solve	Work with team to problem solve	Work with team to problem solve/Root cause analysis	Knowledge of problem solving models (Form, storm, norm, and perform). Thinking critically and understanding critical analysis, active versus passive listening skills, and questioning techniques.	Know how a team functions to question and solve problems. Respect other team members ideas and suggestions	Know problem solving process (5Y = why, why, why, why, why?)

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			Flexibility and adaptability.		
Team management		Team coach/mentor	Leadership knowledge and skills		Knowledge of coaching and mentoring techniques
Project/task planning and implementation	Focus on end-results		Knowledge and skills to plan and perform as a team	Able to visualize end product/results	
Team analysis			Knowledge to plan, organize, evaluate and assess team performance.		
		SPC (SPC = Statistical Process Control)			Know and understand SPC methodologies (use case studies and real world practice in curriculum)
	Listen to others/seek to understand	Listen to others		Listening skills and identify valuable information	Knows and demonstrates listening techniques
	Use questioning techniques/frequently ask questions	Ask questions		Knows how, when, and why to ask questions	Knows questioning techniques
	Role play	Respect other team members ideas and suggestions		Knows how to approach from different perspectives	Understand other peoples feelings and perspectives
	Interact in a union environment			Know the role of the union and effects in a composites shop	
		Persuade others to visit concepts			Knows communication and

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					negotiation skills
	Takes responsibility for mistakes			Understands the importance of identifying mistakes	
		Build consensus			Knows consensus building techniques
		Participates as a team member			Knows what their part is in a team and how to share ideas
		Deal with diversity			Knows how to interact with different personalities, characteristics, handicaps, diversities, etc.

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<p>Instructional Topic Area: Manufacturing Economics (Core Course)</p> <p>(St Louis SME focus group suggested using: Manufacturing Systems and Economics)</p>					
Contribute to organizations current and future profitability	Plan and reflect	Compare relationship between materials and fabrication costs	Understand manufacturing economics including manufacturing cost and profitability	Knowledge of different limitations of activities and task and order for maximizing efficiency	Know relationship between materials and fabrication costs
Use 5-S / 6-S strategies	Use 5-S strategies/ 6-S (Safety)		Sort, simplify, sweep, standardize, self discipline, safety (6 th S)	Knows 5-S/6-S process and significance	
Follow lean manufacturing practices	Follow lean manufacturing practices	Follow lean manufacturing practices	Understands basic concepts of lean manufacturing practices	Knows lean manufacturing processes including: <ul style="list-style-type: none"> • Kaizen • a “pull” inventory control system • just-in-time inventory system • continuous improvement processes • Manage/mini mize waste 	Know lean manufacturing processes including TAKT time, manage/minimize waste

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Employ continuous improvement processes		Employ continuous improvement processes	Understands continuous improvement (i.e., kaizen, etc.) strategies for continuous improvement		Know how and will to employ continuous improvement processes
Inventory Management		Identify materials in relation to life-cycle	Use a “pull” inventory control system Use just-in-time inventory system		Able to determine working life and shelf life of materials
Meet production schedules	Follow production schedules	Follow and meet production schedules	Understands production flow and cycles. Able read and follow schedules.	Knowledge of individual impact to production schedules	Understand work scheduling, forecasting, cycle time, lead time, critical path (critical path = longest lead time it takes to build a part)
	Workplace skills/life skills			Shows up on time, ready to work, in proper dress...	
	Flexibility – producing different mixes or greater diversity of products quickly using a variety of job skills			Knows many areas and skills sets	
Specify value/quality in the eyes of the internal/external customer	Work with customers	Specify value in the eyes of the customer	Understands that the internal/external customer has expectations and quality needs	Knowledge of company standards, security, and disclosure issues	Knows what customer expectations are

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Work with suppliers	Work with suppliers	Appreciate value stream	Provides appropriate input and feedback to suppliers	Knowledge of company standards, security, and disclosure issues	Know the purpose of the value stream
	Build first-time quality	Achieve first-time quality		Follow directions and call attention to the anomomies	Know and understand quality production process (introduce six sigma)
	Project task planning			Knows how to interpret specifications and plan the task	
		Flexibility – perform multiple build processes			Know how to and be willing to perform a variety of task and jobs
		Build relationships and work with suppliers and customers			Know how to and be willing to work with suppliers and customers
		Aid and help develop processes			Knowledge of how to make changes in development processes including: planning and controlling documents
		Performance metrics			Know how to interpret performance metrics

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<p>Instructional Topic Area: Introduction to Composites/Lab</p> <p>(Everett/Edmonds SME focus group suggested Composites Processes and Applications)</p>					
		Work in the composites industry			Knowledge of the composites industry and applications
Recognize products made from composite materials		Recognize products made from composite materials	Knowledge of RTM, VARTM, injection molding, filament winding, fiber placement, compression, bag molding, pultrusion, tube rolling, thermoforming, extrusion, and hand lay-up		Knowledge of and processes selected for RTM, injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement
Distinguish between different fiber lay-up methods	Distinguish between different fiber lay-up methods	Distinguish between different fiber lay-up methods	Knowledge of wet lay-up, RTM, VARTM, injection molding, tape placement, filament winding, fiber placement, compression, bag molding, autoclave, pultrusion, tube rolling, thermoforming, and extrusion	Knowledge of RTM, VARTM, injection molding, filament winding, fiber placement, compression, bag molding, pultrusion, tube rolling, thermoforming, extrusion, and hand lay-up	Knowledge of and processes selected for RTM, injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement

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Read engineering drawings, specification sheets and work orders	Read specification sheets and manufacturing documents, lay-up plans, and engineering drawings	Read process specification drawing and work order instructions	Knowledge and skills to read engineering drawings, specification sheets and work orders	Knowledge and skills to read specification sheets and manufacturing documents, lay-up plans, and engineering drawings	Knowledge and skills to read process specification drawing and work order instructions
Prepare polymer/resin mix per specifications; Weigh, measure, mix, and prepare chemicals and specimens per specifications			Ability to follow specifications and measure, mix polymers/resins and additives. Read and understand pressure gauges and measuring devices. Understand tolerances.		
Perform hand lay-up (prepreg vs. wet)	Perform hand lay-up (prepreg vs. wet)	Perform hand lay-up (prepreg vs. wet)	Knowledge of how to perform hand lay-up and read follow a manufacturing plan. Ability to follow a manufacturing plan	Knowledge of how to perform hand lay-up and read follow a manufacturing plan. Ability to follow a manufacturing plan	Knowledge of how to perform hand lay-up and read follow a manufacturing plan.
Use basic tools (tooling-moulds)	Identify basic hand tools	Identify basic tools	Knowledge of tools and tooling considerations for each process Understanding of different properties of heat and pressure	Knowledge of tooling considerations for each process	Knowledge of tooling considerations for each process Understanding of different properties of heat and pressure (use detailed examples in the curriculum)
	Identify basic			Understanding of	

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	composites lay-up tooling			different properties of heat and pressure	
	Keeps shop area clean			Willingness to keep shop area clean	
Identify sources of damage in work area and recognize in process/ handling damage	Identify sources of damage in work area and recognize in process/handling damage	Identify sources of parts damage in work area and recognize in process/handling damage	<ul style="list-style-type: none"> • Knowledge of potential process and handling damage. • Basic NDT techniques • Follows good ethical practices 	Knowledge of potential process and handling damage (<i>For instruction use photos of typical damage</i>)	Knowledge of potential process and handling damage Knowledge of NDT (NTD = non-destructive testing) (<i>For instruction use photos of typical damage, defects, and causes</i>)
Perform secondary operations (i.e., Trims, finishes, and assembles parts) according to specifications		Perform repairs	Knowledge and skills to perform secondary operations		Knowledge of repair procedures, heat blanket and lamps
	Program process and locating equipment			Able to program ovens, autoclaves, laser projections (Ramp time)	
		Use quality inspection tools			Know when and how to use quality inspection tools
	Prepare polymer/resin mix per specifications; Weigh, measure, mix, and prepare chemicals and	Prepare polymer/resin mix per specifications; Weigh, measure, mix, and prepare		Ability to follow specifications and mix adhesives /resins and additives (add math and ratios	Ability to follow specifications and mix polymers/resins, chemicals/ adhesives and additives

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	specimens per specifications	chemicals/adhesives and specimens per specifications		to curriculum)	
	Use different manufacturing methods	Use different manufacturing methods		Knowledge and skills to properly perform RTM, VARTM, filament winding, fiber placement, compression, bag molding, pultrusion, tube rolling, thermoforming, and extrusion (use multiple labs)	Knowledge and skills to properly perform RTM (resin transfer molding), injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement
		Determine proper surface prep and prepare materials for testing			What the sample represents in relationship to past and the associated requirements
		Follow clean room and controlled environment procedures			KSA to properly procedures for working in a clean room and controlled environment
Safety —Wear proper clothing per work environment	Safety —Wear proper clothing per work environment per specifications	Safety —Wear proper clothing per work environment	Knowledge and willingness to wear proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment
Safety —Use appropriate personal	Safety —Use appropriate personal	Safety —Use appropriate personal	Knowledge and skills to put on (don) and	Knowledge and skills to don and use	Knowledge, skills and willingness to

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protective equipment	protective equipment	protective equipment (PPE)	use appropriate personal protective equipment	appropriate personal protective equipment	don and use appropriate personal protective equipment
Safety —Log tools (ingress/egress)	Safety —Log tools (ingress/egress) FOD control (FOD == foreign object damage)		Knowledge of proper procedures to log tools (ingress/egress)	Knowledge of procedures to log tools (ingress/egress)	
Safety —Tether tools and personal items	Safety —Tether tools and personal items		Knowledge of proper procedures to tether tools and personal items	Knowledge of procedures to tether tools and personal items	
Safety —Use appropriate lifting techniques	Safety —Use appropriate lifting techniques	Safety —Use appropriate lifting techniques	Knowledge and skills to safely lift items	Knowledge and skills to safely lift items	Knowledge and skills to safely lift items
Safety —Place catch nets	Safety —Place catch nets and fall protection	Safety —Wear appropriate harness equipment	Knowledge and skills to properly place catch nets	Knowledge to properly place catch nets and use fall protection	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Safety —Set up and maintain safe work area	Safety —Set up and maintain safe work area	Knowledge of safe work areas	Knowledge of safe work areas	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Safety —Use lock out/tag out procedures	Safety —Use lock out/tag out procedures	Knowledge of lock out/tag out procedures	Knowledge of lock out/tag out procedures	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Safety —Use buddy system where required	Safety —Use buddy system where required	Knowledge of when and how to use the buddy system for safety.	Knowledge of when and how to use the buddy system for safety.	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and	Safety —Monitor breathing zones and	Safety —Monitor breathing zones and	Knowledge of monitoring breathing	Knowledge of monitoring breathing	Knowledge of monitoring breathing

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wind direction	wind direction	air flow	zones and wind direction	zones and wind direction	zones and air flow
Safety —Follow clean room and controlled environment procedures	Safety —Safely uses chemicals and potentially hazardous substances	Safety —Safely uses chemicals and potentially hazardous substances	KSA to properly procedures for working in a clean room and controlled environment	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances (Make this number two in order of teaching)	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances
Safety —Safely uses chemicals and potentially hazardous substances			Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances. Recognize potential allergic reactions some people have to composites and chemicals		
Safety —Uses MSDS (Material Data Safety Sheets) properly	Safety —Uses MSDS (Material Data Safety Sheets) properly	Safety —Uses MSDS (Material Data Safety Sheets) properly	Knowledge and skills to read and properly follow MSDS	Knowledge and skills to read and properly follow MSDS (Make this number one in order of teaching)	Knowledge and skills to read and properly follow MSDS
Safety —Seeks medical attention if experiencing a personal physical reaction	Safety —Seeks medical attention if experiencing a personal physical reaction	Safety —Seeks medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials	Know how to identify reactions and when to seek medical attention	Knowledge potential physical reactions to composite materials
	Safety —Use confined area safety practices			Knowledge of confined area safety	

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	Safety —Spill			practices	
	procedures control			Knows spill	
	Safety —Shop			procedures control	
	equipment safety			Knows shop	
	Put in glossary of			equipment safety	
	terms:				
	Safety —Follow clean				
	room and controlled				
	environment				
	procedures				

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<p>Instructional Topic Area: Computer Aided Design</p> <p>(The Everett/Edmonds industry SME focus group stated that computer aided design does not apply to a composites technician position. He argued that a design technician/engineer is a different trade from a composites technician on the shop floor).</p> <p><u>(Cerritos suggested: Composite Industry Engineering Drawings)</u> (Note: the Cerritos industry SME focus group stated that computer aided design does not apply to a composites technician position. They argued that a design technician/engineer is a different trade from a composites technician bonding mechanic on the shop floor. However, the industry SME's stated that there is a need for reading composite industry engineering drawings).</p> <p>The Cerritos SME's suggested adding a basic shop math course to the curriculum and perhaps combining with the industry engineering drawings.</p> <p><u>(St. Louis suggested: Blueprint Reading and Measurement)</u> (Note: the industry SME's stated that computer aided design does not apply to a composites technician/bonding mechanic position. They argued that a design technician/engineer is a different trade from a composites technician bonding mechanic on the shop floor. However, the industry SME's stated that there is a need for blueprint reading and measurement).</p>					
		<p>Pull blueprint reading and measurement topics from other areas and list here.</p>			
<p>Lay-up fiber orientation</p>				<p>Knows how to interpret rosette, prints, and specifications</p>	

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	Recognizes fabrication defects			Knows common fabrication defects and how to recognize	
	Read 2-D vector based drawings	Read 2-D vector based drawings		<p>Knowledge of how industry standards concerning composites are shown on an engineering drawing.</p> <p>Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail.</p> <p>Knowledge of dimensions and tolerances. (Introduce software views in CATIA, Solidworks, Pro-E, AutoCAD, Master CAM, Unigraphics in curriculum)</p>	<p>Knowledge of how industry standards concerning composites are shown on an engineering drawing.</p> <p>Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail.</p> <p>Knowledge of dimensions and tolerances.</p>
	Read 3-D solid and surface models			<p>Knowledge of how industry standards concerning composites are shown on a 3-D model as well as on an engineering drawing.</p> <p>Knowledge about parts, assemblies, and</p>	

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				engineering drawing, and knowledge about how these are inter-related. Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail. Knowledge of dimensions and tolerances. (Introduce software views in CATIA, Solidworks, Pro-E, AutoCAD, Master CAM, Unigraphics in curriculum)	

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Instructional Topic Area: Certificate Focused Capstone (Core)					
Working in a team, fabricate a composite part according to specification/work order/engineering drawing.	Lay-up and cure a composite part	Fabricate a composite part	Knowledge and skills to fabricate a composite part by interpreting a specification/work order/ engineering drawing and ensure a high level of quality control. Understands tolerances Reads specifications in English	KSA to lay-up and cure a composite part and ensure a high level of quality control (<i>Inspire quality in class</i>)	KSA to fabricate a composite part and ensure a high level of quality control (<i>Inspire quality in class</i>)
Perform secondary operations such as any required trimming, finishing and assembly to specifications	Trims, drills, and finishes parts to specifications	Hole drilling, trimming and finishing parts to specifications	Knowledge and skills to properly perform secondary operations	Knowledge and skills to properly trim, drill, and finish parts (Emphasize drilling in curriculum)	Knowledge and skills to properly drill, trim and finish parts (finish = paint)
	Assembles parts to specifications	Assembles parts to specifications		Knowledge and skills to properly assemble parts	Knowledge and skills to properly assemble parts (bonding – adhesives, bolting)
Maintains and cleans equipment	Maintains and cleans equipment	Maintains and cleans equipment and tools	Knowledge and willingness to maintain and clean equipment	Knowledge and willingness to maintain and clean equipment	Knowledge and willingness to maintain and clean equipment and tools
Keeps shop area clean	Keeps shop area clean	Keeps shop area clean	Willingness to keep shop area clean	Willingness to keep shop area clean	Willingness to keep shop area clean

Aerospace SME Composites Technician Focus Group Correlation

Everett Task 3-26-07	Cerritos Task 4-27-07	StLouis Task 5-17-07	Everett KSA 3-26-07	Cerritos KSA 4-27-07	St Louis KSA 5-17-07
Weigh, measure, mix, mill, and prepare chemicals and specimens per specifications			Know how to weigh, measure, mix, mill, and prepare chemicals and specimens per specifications		
	Follows project instructions and engineering drawings to manufacture and finish parts	Follows project instructions and <u>blueprints</u> to manufacture and finish parts		Comprehension of project instructions and engineering drawings to manufacture parts Understands tolerancing Reads blueprints in English. Plan a composite fabrication part	Comprehension of project instructions and blueprints to manufacture parts Understands tolerancing Reads blueprints in English
	Recognize potential defects	Follows project instructions and blueprints to lay-up test specifications		Knowledge and skills to operates test equipment to analyze and document composites according to the specifications. Knowledge of potential defects	Knowledge and skills to lay-up test specimens according to the specifications
	Set up and conduct in process quality control test			Know how to set up and conduct in process quality control using inspection hand tools	
	Weigh, measure, mix, and prepare chemicals and specimens per	Weigh, measure, mix, mill, and prepare chemicals and		Know how to weigh, measure, mix, and prepare chemicals and	Be able to weigh, measure, mix, mill, and prepare

Aerospace SME Composites Technician Focus Group Correlation

Everett Task 3-26-07	Cerritos Task 4-27-07	St Louis Task 5-17-07	Everett KSA 3-26-07	Cerritos KSA 4-27-07	St Louis KSA 5-17-07
	specifications	specimens per specifications		specimens per specifications	chemicals and specimens per specifications
Safety —Wear proper clothing per work environment	Safety —Wear proper clothing per work environment per specifications	Safety —Wear proper clothing per work environment	Knowledge and willingness to wear proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment	Knowledge and willing to don proper clothing for the work environment
Safety —Use appropriate personal protective equipment	Safety —Use appropriate personal protective equipment	Safety —Use appropriate personal protective equipment (PPE)	Knowledge and skills to don and use appropriate personal protective equipment	Knowledge and skills to don and use appropriate personal protective equipment	Knowledge, skills and willingness to don and use appropriate personal protective equipment
Safety —Log tools (ingress/egress)	Safety —Log tools (ingress/egress) FOD control (FOD == foreign object damage)		Knowledge of proper procedures to log tools (ingress/egress)	Knowledge of procedures to log tools (ingress/egress)	
Safety —Tether tools and personal items	Safety —Tether tools and personal items		Knowledge of proper procedures to tether tools and personal items	Knowledge of procedures to tether tools and personal items	
Safety —Use appropriate lifting techniques	Safety —Use appropriate lifting techniques	Safety —Use appropriate lifting techniques	Knowledge and skills to safely lift items	Knowledge and skills to safely lift items	Knowledge and skills to safely lift items
Safety —Place catch nets	Safety —Place catch nets and fall protection	Safety —Wear appropriate harness equipment	Knowledge and skills to properly place catch nets	Knowledge to properly place catch nets and use fall protection	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Safety —Set up and maintain safe work area	Safety —Set up and maintain safe work area	Knowledge of safe work areas	Knowledge of safe work areas	Knowledge of safe work areas

Aerospace SME Composites Technician Focus Group Correlation

Everett Task 3-26-07	Cerritos Task 4-27-07	St Louis Task 5-17-07	Everett KSA 3-26-07	Cerritos KSA 4-27-07	St Louis KSA 5-17-07
Safety —Use lock out/tag out procedures	Safety —Use lock out/tag out procedures	Safety —Use lock out/tag out procedures	Knowledge of lock out/tag out procedures	Knowledge of lock out/tag out procedures	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Safety —Use buddy system where required	Safety —Use buddy system where required	Knowledge of when and how to use the buddy system for safety.	Knowledge of when and how to use the buddy system for safety.	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and wind direction	Safety —Monitor breathing zones and wind direction	Safety —Monitor breathing zones and air flow	Knowledge of monitoring breathing zones and wind direction	Knowledge of monitoring breathing zones and wind direction	Knowledge of monitoring breathing zones and air flow
Safety —Follow clean room and controlled environment procedures			KSA to properly procedures for working in a clean room and controlled environment		
Safety —Safely uses chemicals and potentially hazardous substances	Safety —Safely uses chemicals and potentially hazardous substances	Safety —Safely uses chemicals and potentially hazardous substances	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances (Make this number two in order of teaching)	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Safety —Uses MSDS (Material Data Safety Sheets) properly	Safety —Uses MSDS (Material Data Safety Sheets) properly	Knowledge and skills to read and properly follow MSDS	Knowledge and skills to read and properly follow MSDS (Make this number one in order of teaching)	Knowledge and skills to read and properly follow MSDS
Safety —Seeks medical attention if	Safety —Seeks medical attention if	Safety —Seeks medical attention if	Knowledge potential physical reactions to composite materials	Know how to identify reactions and when to seek medical attention	Knowledge potential physical reactions to composite materials

Aerospace SME Composites Technician Focus Group Correlation

Everett Task 3-26-07	Cerritos Task 4-27-07	StLouis Task 5-17-07	Everett KSA 3-26-07	Cerritos KSA 4-27-07	St Louis KSA 5-17-07
experiencing a personal physical reaction	experiencing a personal physical reaction	experiencing a personal physical reaction			
	Safety —Use confined area safety practices			Knowledge of confined area safety practices	
	Safety —Spill procedures control			Knows spill procedures control	
	Safety —Shop equipment safety			Knows shop equipment safety	

Aerospace SME Composites Technician Focus Group Correlation

Companies that participated in this project nationwide included:

- BE Aerospace Flight Structures
- Composites Technology Corporation
- GKN Aerospace
- Hitco Carbon Composites
- Lockheed Martin Corporation
- Northrop Grumman Corporation
- The Boeing Company
- Tiffin Technologies

Institutions that participated in this project nationwide included:

- Cerritos College
- Edmonds Community College
- Everett Community College
- St. Louis Community College Florissant Valley
- University of Washington

Advanced Manufacturing Materials (Core Course)

Performance Task	Performance Indicators	KSAs
Opportunities in the composites industry	Describe potential career opportunities in the composites industry	Knowledge of the composites industry and applications Recognize potential allergic reactions some people have to composites and chemicals/know history of composites industry
Recognize manufacturing materials	Describe manufacturing materials	Knowledge of polymers and reinforcements used in composites construction
Use materials and composites industry terminology	Define key materials and composite terms	Know and understand the key materials and composites industry terms
Identify why composites are used in the marine industry	Explain why composites would be used compared to standard materials	Know characteristics of composites verses traditional materials (Fastnet Race started the education about composites)
Identify specific applications for different composite materials	Describe different types of resins, reinforcements, and core materials	Knowledge of different types of resins, reinforcements, and core materials. Try to repair with like materials
Distinguish between composites and other materials	Selects the proper material	Knowledge of differences between properties composite and other materials (science behind materials)
Determine correct gel coat per application	Distinguish between different gel coats	Knowledge of the different gel coats
Determine correct resins per	Distinguish between different resins	Knowledge of the different resins and

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Performance Task	Performance Indicators	KSAs
application	(Ortho and ISO resin)	their uses. Knowledge of thermoset and thermoplastic
Identify different fillers per specifications	Distinguish between different fillers and additives	Knowledge of the different fillers and their uses (for boat repair industry)
Proper storage and handling per specifications	Select the proper composite materials to withstand specific environmental effects	Knowledge of the environmental effects on composite materials. Knowledge of storage and handling—proper removal and log document out time and in time.
Determine proper mold (tool) prep	Ensure mold (tool) is clean, properly applied release, and prepped for lay-up	Know how to apply release agent and know what to use and how to clean mold (tool).
Follow specifications for composite materials for specific environments	Select the proper composite materials to withstand specific environmental effects	Knowledge of the environmental effects on composite materials (cover quickly – minimal emphasis)
Select core materials per specifications	Distinguish between different core materials (i.e., honeycomb)	Knowledge of types and purposes of core materials
Identify specific applications per adhesive materials	Properly select adhesives per specific applications	Knowledge of specific adhesives and their applications
Safety —Safely uses and disposes of materials, chemicals, and potentially hazardous substances	Explain proper handling, use, and disposal of materials, chemicals, and potentially hazardous substances	Knowledge of proper handling, use, and disposal of materials, chemicals, and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS
Safety —Reports to supervisor and seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to report to supervisor and seek medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials

Enterprise Teaming (Core Course)

Performance Task	Performance Indicators	KSAs
Communicate and interact across culture	Describe different lines of communication	Know what others need to know and why they need to know it. Use interpersonal skills at multiple levels
Work as part of a manufacturing team	Define role as team members	Understand basics of team dynamics
Work with team to problem solve/Root cause analysis	Describe problem solving process	Know problem solving process
Focus on end-results	Starts with the end in mind	Able to visualize end product/results
Team coach/mentor	Describe situations needing coaching and or mentoring	Knowledge of coaching and mentoring techniques
Listen to others	Demonstrates listening techniques	Knows and demonstrates listening techniques
Respect other team members ideas and suggestions	Demonstrates respect for others (Plays well with others)	Understand other peoples feelings and perspectives
Takes responsibility for mistakes	Identifies mistakes	Understands the importance of identifying mistakes
Build consensus	Explain consensus building techniques	Knows consensus building techniques
Sacrifice personal views for benefit of team	Sacrifices personal views for benefit of team	Knows the value of the end goal
Ask questions	Use questioning techniques that lead to obtaining answers	Knows questioning techniques
Participates as a team member	Actively participates in a team	Knows what their part is in a team and how to share ideas
Deal with diversity	Works well with others	Knows how to interact with different personalities, characteristics,

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Performance Task	Performance Indicators	KSAs
		handicaps, diversities, etc.

Manufacturing Economics (Core Course)

Performance Task	Performance Indicators	KSAs
Compare relationship between materials and fabrication costs	Identify and select the best material from and economic perspective	Know relationship between materials and fabrication costs
Identify materials in relation to life-cycle	Calculate and record material life expiration	Able to determine working life and shelf life of materials
Employ continuous improvement processes	Describe why and how to use continuous improvement processes	Know how and will to employ continuous improvement processes
Follow and meet production schedules	Meet production schedules	Understand work scheduling, forecasting, cycle time, lead time, critical path (critical path = longest lead time it takes to build a part)
Workplace skills/life skills	Demonstrate workplace skills/life skills	Shows up on time, ready to work, in proper dress...
Flexibility – producing different mixes or greater diversity of products quickly using a variety of job skills	Cross-trained	Knows many areas and skills sets
Customer interaction	Interacts well with customers	Able to interact well with customers
Specify value in the eyes of the customer	Meets customer expectation	Knows what customer expectations are
Pride in workmanship within job restraints	Demonstrates pride in workmanship within job restraints	Knows how to do quality work towards a main goal (Do what is necessary and quit – by Sam Coulter during Depression)
Achieve first-time quality	Meet all quality metrics	Know and understand quality

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Performance Task	Performance Indicators	KSAs
		production process
Flexibility – perform multiple build processes	Self directed in charge of task and jobs	Know how to and be willing to perform a variety of task and jobs
Build relationships and work with suppliers and customers	Works well with suppliers and customers	Know how to and be willing to work with suppliers and customers
Keep company’s profitability in mind	Explain relationship between company’s profitability and their employment success.	Know the relationship between the company’s profitability and their job

Introduction to Composites/Lab

Performance Task	Performance Indicators	KSAs
Work in the composites industry	Describe potential marine career opportunities in the composites industry	Knowledge of the composites industry and applications
Distinguish between different fiber lay-up methods	Identify RTM (resin transfer molding), bag molding, wet lay-up, infusion, chopper gun	Knowledge of and processes selected for RTM (resin transfer molding), bag molding, wet lay-up, infusion, chopper gun
Read process specification drawing and work order instructions	Explain data and details on process specification drawing and work order instructions	Knowledge and skills to read process specification drawing and work order instructions
Prepare polymer/resin mix per specifications; Weigh, measure, mix, and prepare chemicals and specimens per specifications	Follow the specifications to demonstrate correct polymer/resin mixing procedures	Ability to follow specifications and measure, mix polymers/resins and additives. Read and understand pressure gauges and measuring devices. Understand tolerances. (Very Important!)

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Perform hand lay-up (wet)	Demonstrate hand lay-up and follow a manufacturing plan	Knowledge of how to perform hand lay-up and read follow a manufacturing plan.
Proper de-molding and mold care	Demonstrate proper de-molding and care throughout the process and life of the mold	Know when and be able to properly de-mold and care for molds
Properly use hand tools (brushes)	Demonstrate proper hand tool use (emphasis on brush use and resin application)	Knows how to properly use hand tools (and apply resin with a brush)
Identify sources of parts damage in work area and recognize in process/handling damage	Demonstrate proper handling techniques	Knowledge of potential process and handling damage Knowledge of NDT (NTD = non-destructive testing) <i>(For instruction use photos of typical damage, defects, and causes)</i>
Keeps shop area clean while maintaining productivity	Keeps a clean work area while maintaining productivity	Willingness to keep shop area clean and maintain productivity
Perform repairs	Demonstrate successful repair	Knowledge of repair procedures, heat lamps and heaters
Prepare polymer/resin mix per specifications; Weigh, measure, mix, and prepare chemicals/adhesives and specimens per specifications	Follow the specifications to demonstrate correct polymer/resin , chemicals/adhesives mixing procedures	Ability to follow specifications and mix polymers/resins, chemicals/ adhesives and additives
Use different manufacturing methods	Perform RTM (resin transfer molding), bag molding, wet lay-up, infusion, chopper gun	Knowledge and skills to properly perform RTM (resin transfer molding), bag molding, wet lay-up, infusion, chopper gun
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment

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Safety —Use appropriate personal protective equipment (PPE)	Demonstrates appropriate personal protective equipment to meet OSHA standards	Knowledge, skills and willingness to don and use appropriate personal protective equipment
Safety —Use appropriate lifting techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety —Wear appropriate harness equipment	Demonstrates properly wearing of harness equipment in accordance with OSHA	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with OSHA	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and air flow (occasionally)	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow
Safety —Safely uses chemicals and potentially hazardous substances	Demonstrates proper handling, use, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS
Safety —Notifies supervisor and seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek and report medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials

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Composites Drawings (Marine focus group suggested "Composite Drawings")

Performance Task	Performance Indicators	KSAs
Make ruler and scale measurements	Demonstrates how to make a ruler and scale measurement	Knows to make a ruler and scale measurement
Lay-up fiber orientation	Demonstrate correct ply orientation per specifications	Knows how to interpret rosette (fiber orientation) , prints, and specifications
Read basic marine (layup) drawings	Demonstrates reading basic marine (layup) drawings	Knows how to read basic marine drawings (layup) and read drawing scales

Certificate Focused Capstone (Core)

Performance Task	Performance Indicators	KSAs
Fabricate a composite part	Fabricates and inspects a composite part	KSA to fabricate a composite part and ensure a high level of quality control <i>(Inspire quality in class)</i>
Hole drilling, trimming and finishing parts to specifications (including wet trimming)	Properly drill, trim and finish parts according to specifications (including wet trimming)	Knowledge and skills to properly drill, trim and finish parts (finish = paint) (including wet trimming)
Assembles parts to specifications	Properly assembled part to specifications	Knowledge and skills to properly assemble parts (bonding - adhesives, bolting)
Make secondary bonds	Properly prepares and makes secondary bonds	Knows how to properly prepare and makes secondary bonds
Maintains and cleans equipment and hand tools	Demonstrates basic equipment and hand tool maintenance and cleaning	Knowledge and willingness to maintain and clean equipment and hand tools
Keeps shop area clean	Keeps a clean work area	Willingness to keep shop area clean
Follows project plans and drawings to manufacture and finish parts	Performs task following project plans and drawings to manufacture and finish parts	Comprehension of project plans and drawings to manufacture parts Understands tolerancing Reads blueprints in English
Weigh, measure, mix, mill, and prepare chemicals and specimens per specifications	Accurately scale materials according to specifications	Be able to weigh, measure, mix, mill, and prepare chemicals and specimens per specifications
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willing to don proper clothing for the work environment
Safety —Use appropriate personal protective equipment (PPE)	Demonstrates appropriate personal protective equipment to meet OSHA	Knowledge, skills and willingness to don and use appropriate personal

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Performance Task	Performance Indicators	KSAs
	standards	protective equipment
Safety —Use appropriate lifting techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety —Wear appropriate harness equipment	Demonstrates properly wearing of harness equipment in accordance with OSHA	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with OSHA	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and air flow (occasionally)	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow
Safety —Safely uses chemicals and potentially hazardous substances	Demonstrates proper handling, use, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS
Safety —Notifies supervisor and seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek and report medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials

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Participant List

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Advanced Manufacturing Materials (Core Course)

Performance Task	Performance Indicators	KSAs
Opportunities in the composites industry	Describe potential career opportunities in the composites industry	Knowledge of the composites industry and applications Recognize potential allergic reactions some people have to composites and chemicals/know history of composites industry
Recognize manufacturing materials	Describe manufacturing materials – structure	Knowledge of polymers and reinforcements used in composites construction compared to metals
Use materials and composites industry terminology	Define key materials and composite terms	Know and understand the key materials and composites industry terms
Identify why composites are used in the marine industry	Explain why composites would be used compared to standard materials	Know characteristics of composites verses traditional materials
Identify specific applications for different marine and transportation composite materials	Describe different types of resins, reinforcements, and core materials	Knowledge of different types of resins, reinforcements, and core materials Segment per application
Distinguish between composites and other materials	Selects the proper material	Knowledge of differences between properties composite and other materials
Determine correct materials per final product application	Distinguish between different materials and follow final product application/instructions	Knowledge of the different materials, surface treatments, and their uses
Determine correct resins and matrices per application	Distinguish between different resins and matrices	Knowledge of the different resins and their uses

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Performance Task	Performance Indicators	KSAs
		Knowledge of thermoset and thermoplastic
Identify different fillers per application	Distinguish between different fillers and additives	Knowledge of the different fillers and their uses
Proper storage and handling per data sheets and MSDS	Select the proper composite materials to withstand specific environmental effects	Knowledge of the environmental effects on composite materials. Knowledge of storage and handling—proper removal and log document out time and in time.
Determine proper tool prep	Ensure tool is clean, properly applied release, and prepped for lay-up	Know how to apply release agent and know what to use and how to clean tool. (Cleaning, sealing, and releasing)
Follow OSHA and state laws, and best practices for composite materials for specific environments	Select the proper composite materials to withstand specific environmental effects	Knowledge of the environmental effects on composite materials
Select core materials per specifications	Distinguish between different core materials (i.e., honeycomb, foam, balsa, etc)	Knowledge of types and purposes of core materials (Look at ASMI book on core materials – see chapter by Jim Kindinger)
Identify specific applications per adhesive materials	Properly select adhesives per specific applications	Knowledge of specific adhesives and their applications
Safety —Safely uses and disposes of materials, chemicals, and potentially hazardous substances	Explain proper handling, use, and disposal of materials, chemicals, and potentially hazardous substances	Knowledge of proper handling, use, and disposal of materials, chemicals, and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS

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Performance Task	Performance Indicators	KSAs
Safety —Seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials

Enterprise Teaming (Core Course)

Performance Task	Performance Indicators	KSAs
Communicate and interact across culture	Describe different lines of communication	Know what others need to know and why they need to know it. Use interpersonal skills at multiple levels
Work as part of a manufacturing team	Define role as team members	Understand basics of team dynamics
Participates as a team member	Actively participates in a team	Knows what their part is in a team and how to share ideas
Work with team to problem solve/Root cause analysis	Describe problem solving process	Know problem solving process
Focus on end-results	Starts with the end in mind	Able to visualize end product/results
SPC (SPC = Statistical Process Control)	Describe SPC process	Know and understand SPC methodologies (use case studies and real world practice in curriculum) (Basic understanding)
Team coach/mentor	Describe situations needing coaching and or mentoring	Knowledge of coaching and mentoring techniques
Listen to others	Demonstrates listening techniques	Knows and demonstrates listening techniques
Respect other team members ideas and suggestions	Demonstrates respect for others (Plays well with others)	Understand other peoples feelings and perspectives

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Performance Task	Performance Indicators	KSAs
Negotiation skills	Demonstrate negotiating skills	Knows communication and negotiation skills Knowledge of techniques and approaches that others are using.
Takes responsibility for mistakes	Identifies mistakes	Understands the importance of identifying mistakes
Build consensus	Explain consensus building techniques	Knows consensus building techniques
Ask questions	Use questioning techniques that lead to obtaining answers	Knows questioning techniques
Deal with diversity	Works well with others	Knows how to interact with different personalities, cultures, characteristics, handicaps, diversities, etc.

Manufacturing Economics (Core Course)

Performance Task	Performance Indicators	KSAs
Follow lean manufacturing practices	Demonstrate lean manufacturing practices including 5-S, Kaizen, pull-inventory, JIT inventory	Know lean manufacturing processes including TAKT time, manage/minimize waste
Compare relationship between materials and fabrication costs	Identify and select the best material from and economic perspective	Know relationship between materials and fabrication costs
Use 5-S strategies/ 6-S (Safety)	Describes 5-S/6-S	Knows 5-S/6-S process and significance
Identify materials in relation to life-cycle	Calculate and record material life and post mixing expiration (i.e., prepreg out time)	Able to determine working life, post mixing, and shelf life of materials
Employ continuous improvement	Describe why and how to use	Know how and willing to employ

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Performance Task	Performance Indicators	KSAs
processes	continuous improvement processes	continuous improvement processes
Follow and meet production schedules	Meet production schedules	Understand work scheduling, forecasting, cycle time, lead time, critical path (critical path = longest lead time it takes to build a part)
Workplace skills/life skills	Demonstrate workplace skills/life skills	Shows up on time, ready to work, in proper dress...
Flexibility - producing different mixes or greater diversity of products quickly using a variety of job skills Flexibility - perform multiple build processes	Cross-trained Self directed in charge of task and jobs	Knows many areas and skills sets Know how to and be willing to perform a variety of task and jobs
Specify value in the eyes of the customer	Meets customer expectation	Knows what customer expectations are and know the true value of part
Appreciate value stream	Identify value stream	Know the purpose of the value stream
Achieve first-time quality	Meet all quality metrics	Know and understand quality production process (introduce six sigma)
Aid and help develop processes	Helping make completed revisions	Knowledge of how to make changes in development processes including: planning and controlling documents
Performance metrics	Define key performance metrics	Know how to interpret performance metrics

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Introduction to Composites/Lab

Performance Task	Performance Indicators	KSAs
Work in the composites industry	Describe potential marine and transportation career and employment opportunities in the composites industry	Knowledge of the composites industry and applications
Recognize products made from composite materials	Describe potential composites products and benefits	Knowledge of and processes selected for RTM, injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement (Look up 20 minute SME composites video)
Distinguish between different fiber lay-up methods	Identify RTM (resin transfer molding), injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, pultrusion, chopper gun/spray-up, VARTM.	
Read drawings and work order instructions	Explain data and details on drawings and work order instructions	Knowledge and skills to read and interpret drawings, manufacturers data sheets, and work order instructions
Prepare polymer/resin mix per manufacturer's specifications; Weigh, measure, mix, and prepare chemicals and specimens per manufacturers specifications	Follow the manufacturer's recommendations to demonstrate correct polymer/resin mixing procedures	Ability to follow specifications and measure, mix polymers/resins and additives. Read and understand vacuum/pressure gauges and measuring devices. Understand tolerances, weight, measures, and ratios.
Perform hand lay-up (prepreg vs wet)	Demonstrate hand lay-up and follow a	Knowledge of how to perform hand

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	manufacturing plan	lay-up and read follow a manufacturing plan.
Identify basic tools	Describe do's and don'ts of basic tools Explains heat and pressure's related to tooling	Knowledge of tooling considerations for each process Understanding of different properties of heat and pressure (use detailed examples in the curriculum)
Identify sources of parts damage in work area and recognize in process/handling damage	Demonstrate proper handling techniques	Knowledge of potential process and handling damage Knowledge of NDT (NTD = non-destructive testing) <i>(For instruction use photos of typical damage, defects, and causes)</i>
Identify basic composites lay-up tooling	Explains heat and pressure as related to tooling	Understanding of different properties of heat and pressure
Keeps shop area clean	Keeps a clean work area	Willingness to keep shop area clean and clean as you go
Perform repairs	Demonstrate successful repair	Knowledge of repair procedures, heat blanket and lamps
Use quality inspection tools	Demonstrate proper use of quality inspection tools	Know when and how to use quality inspection tools
Use different manufacturing methods	Perform RTM (resin transfer molding), injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, pultrusion, chopper gun/spray-up, VARTM.	Knowledge and skills to properly perform RTM (resin transfer molding), injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, pultrusion, chopper gun/spray-up,

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		VARTM.
Determine proper surface prep for tools	Properly prepare tools	Identify and know what chemicals to use for tool prep
Determine proper prep for materials testing	Properly prepare test specimens	What the sample represents in relationship to past and the associated requirements
Make hole repairs	Properly inspects and makes hole repairs	Knowledge and skills of methods and tools to inspect and make hole repairs
Make surface repairs	Properly inspects surface blemishes and makes repairs	Knowledge and skills of methods and tools to inspect surface blemishes and makes repairs
Make structural repairs	Properly inspects makes structural repairs	Knowledge and skills of methods and tools to inspect and make structural repairs
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment
Safety —Use appropriate personal protective equipment (PPE)	Demonstrates appropriate personal protective equipment to meet OSHA standards	Knowledge, skills and willingness to don and use appropriate personal protective equipment
Safety —Use appropriate lifting and back brace techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with	Knowledge of when and how to use the buddy system for safety.

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	OSHA	
Safety —Monitor breathing zones and air flow	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow
Safety —Safely uses, handles, and stores chemicals and potentially hazardous substances	Demonstrates proper handling, use, storage, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, storage, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS Knows how to lace a MSDS sheet
Safety —Seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek and report medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials
Safety —Safe ingress/egress	Explain ingress/egress plans in case of an emergency	Knowledge of safety ingress/egress issues

Composites Part Drawings

Performance Task	Performance Indicators	KSAs
Perform shop math functions	Demonstrates shop math	Knows and understands shop math including ratios, weights and measures (Teach core shop math)
Read and interpret decimal and fractional rule	Explain difference between decimal rule and functional rule	Understand the difference between and equivalence in decimal and imperial fractions (i.e., drill bit selection, tap and die selection, measurement, etc.)
Use hand measuring tools	Demonstrate proper selection and use	Knows weights and measures and

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Performance Task	Performance Indicators	KSAs
	of hand measurement tools	how to read measuring tools (rulers, micrometers, scales, etc.)
Lay-up fiber orientation	Demonstrate correct ply orientation per specifications	Knows how to interpret rosette, prints, and specifications
Reads dimensions and tolerances	Read and interpret dimensions and tolerances	Knowledge of dimensions and tolerances
Read 2-D vector based drawings	Demonstrate working knowledge on L and D vector drawings	<p>Knowledge of how industry standards concerning composites are shown on an engineering drawing.</p> <p>Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail.</p> <p>Knowledge of dimensions and tolerances.</p> <p>Understands drawing symbols and drawing scales</p> <p>Understands liquids and callouts</p>
Read 3-D solid and surface models	Read and interpret 3-D drawings	<p>Knowledge about parts, assemblies, and engineering drawing, and knowledge about how these are inter-related.</p> <p>Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail.</p> <p>Knowledge of dimensions and tolerances.</p>

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Certificate Focused Capstone (Core)

Performance Task	Performance Indicators	KSAs
Maintains and cleans equipment and tools	Demonstrates basic equipment and tool maintenance and cleaning	Knowledge and willingness to maintain and clean equipment and tools
Keeps shop area clean	Keeps a clean work area	Willingness to keep shop area clean Clean as you go
Fabricate a composite part	Fabricates and inspects a composite part	KSA to fabricate a composite part and ensure a high level of quality control <i>(Inspire quality in class)</i> <i>(Consider building a plug, mold, and part)</i>
Follows project instructions and drawings to manufacture and finish parts	Performs task following project instructions and drawings to manufacture and finish parts	Comprehension of project instructions and drawings to manufacture parts Understands tolerances Reads blueprints in English
Weigh, measure, mix, mill, and prepare chemicals and materials for part	Accurately scale materials according to drawings	Be able to weigh, measure, mix, mill, and prepare chemicals and specimens per s drawings
Hole drilling, trimming and finishing parts to drawings	Properly drill, trim and finish parts according to drawings	Knowledge and skills to properly drill, trim and finish parts (finish = paint) (Highly critical) Proper drill bits to eliminate blowouts, proper jigs, etc.
Assembles parts to drawings	Properly assembled part to drawings	Knowledge and skills to properly assemble parts (bonding - adhesives, bolting) (know differences between

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Performance Task	Performance Indicators	KSAs
		adhesives and epoxy resin and sealant)
Inspect the part	Inspect finished part per drawings and insure completed part fits product drawing per dimensions and tolerances	Knowledge and skills to inspect and finish part per drawings and insure completed part fits product drawing per dimensions and tolerances
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment
Safety —Use appropriate personal protective equipment (PPE)	Demonstrates appropriate personal protective equipment to meet OSHA standards	Knowledge, skills and willingness to don and use appropriate personal protective equipment
Safety —Use appropriate lifting and back brace techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with OSHA	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and air flow	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow
Safety —Safely uses, handles, and stores chemicals and potentially hazardous substances	Demonstrates proper handling, use, storage, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, storage, and disposal of chemicals and potentially hazardous substances

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Performance Task	Performance Indicators	KSAs
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS Knows how to lace a MSDS sheet
Safety —Seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek and report medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials
Safety —Safe ingress/egress	Explain ingress/egress plans in case of an emergency	Knowledge of safety ingress/egress issues

Note: The participants in the focus group tended to represent the secondary automotive (transportation) industry and not the marine industry.

Participant List

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Advanced Manufacturing Materials (Core Course)

Performance Task	Performance Indicators	KSAs
Opportunities in the composites industry	Describe potential career opportunities in the composites industry	Knowledge of the composites industry and applications (Recognize potential allergic reactions some people have to composites and chemicals/know history of composites industry – not at first – week 2 or 3)
Recognize manufacturing materials	Describe manufacturing materials – structure	Knowledge of polymers and reinforcements used in composites construction compared to metals
Use materials and composites industry terminology	Define key materials and composite terms	Know and understand the key materials and composites industry terms
Identify why composites are used in the consumer products industry	Explain why composites would be used compared to standard materials	Know characteristics of composites verses traditional materials
Identify specific applications for different composite materials	Describe different types of resins, reinforcements, and core materials	Knowledge of different types of resins, reinforcements, and core materials
Distinguish between composites and other materials	Recognize composite material	Knowledge of differences between properties composite and other materials
Determine correct materials per specifications	Distinguish between different materials and follow specs	Knowledge of the different materials, surface treatments, and their uses (overview)
Determine correct resins and matrices per application	Distinguish between different resins and matrices	Knowledge of the different resins and their uses

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Performance Task	Performance Indicators	KSAs
		Knowledge of thermoset and thermoplastic
Follow specifications for composite materials for specific environments	Select the proper composite materials to withstand specific environmental effects	Knowledge of the environmental effects on composite materials
Identify different fillers per specifications	Distinguish between different fillers and additives and additives	Knowledge of the different fillers/additives, their properties and their uses
Proper storage and handling per specifications	Select the proper composite materials to withstand specific environmental effects	Knowledge of the environmental effects on composite materials. Knowledge of storage and handling—proper removal and log document out time and in time.
Determine proper tool prep	Ensure tool is clean, properly applied release, and prepped for lay-up	Know how to apply release agent and know what to use and how to clean tool.
Select core materials per specifications	Distinguish between different core materials (i.e., honeycomb, foam, etc.)	Knowledge of types and purposes of core materials
Identify specific applications per adhesive materials	Properly select adhesives per specific applications	Knowledge of specific adhesives and their applications
Safety —Safely uses, stores and disposes of materials, chemicals, and potentially hazardous substances	Explain proper handling, use, store and disposal of materials, chemicals, and potentially hazardous substances	Knowledge of proper handling, use, store, and disposal of materials, chemicals, and potentially hazardous substances (ingress/egress for chemicals)
Safety —Identify various cleaning solvents (acetone, toluene, styrene, environmentally friendly solvents)	Demonstrates proper use of cleaning solvents	Knowledge of potential problems with using cleaning solvents

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Performance Task	Performance Indicators	KSAs
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS and ask questions if doesn't understand it
Safety —Seeks medical attention if experiencing a personal physical reaction immediately	Demonstrates or explains when to seek medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials

Enterprise Teaming (Core Course)

Performance Task	Performance Indicators	KSAs
Communicate and interact across culture	Describe different lines of communication	Know what others need to know and why they need to know it. Use interpersonal skills at multiple levels
Work as part of a manufacturing team	Define role as team members	Understand basics of team dynamics
Work with team to problem solve/Root cause analysis	Describe problem solving process	Know problem solving process
Focus on end-results	Starts with the end in mind	Able to visualize end product/results
SPC (SPC = Statistical Process Control)	Describe SPC process	Know and understand SPC methodologies (use case studies and real world practice in curriculum)
Team coach/mentor	Describe situations needing coaching and or mentoring	Knowledge of coaching and mentoring techniques
Listen to others	Demonstrates listening techniques	Knows and demonstrates listening techniques
Respect other team members ideas and suggestions	Demonstrates respect for others (Plays well with others)	Understand other peoples feelings and perspectives
Persuade others to visit concepts	Demonstrate persuading, selling, negotiating skills	Knows communication and negotiation skills
Interact in a union environment	Define their job and the role of the union and effects in a composites shop	Know the role of the union and effects in a composites shop
Takes responsibility for mistakes	Identifies mistakes	Understands the importance of identifying mistakes
Build consensus	Explain consensus building techniques	Knows consensus building techniques

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Performance Task	Performance Indicators	KSAs
Ask questions	Use questioning techniques that lead to obtaining answers	Knows questioning techniques
Participates as a team member	Actively participates in a team	Knows what their part is in a team and how to share ideas
Deal with diversity	Works well with others	Knows how to interact with different personalities, characteristics, handicaps, diversities, etc.
Team Safety —Awareness of others around you and their tasks	Describes what other team members are doing as part of the team	Knows the positions and responsibilities of others

Manufacturing Economics (Core Course)

Performance Task	Performance Indicators	KSAs
Follow lean manufacturing practices	Demonstrate lean manufacturing practices including 5-S, Kaizen, pull-inventory, JIT inventory	Know lean manufacturing processes including TAKT time, manage/minimize waste (<i>awareness</i>)
Use 5-S strategies/ 6-S (Safety)	Describes 5-S/6-S	Knows 5-S/6-S process and significance (<i>overview</i>)
Identify materials in relation to life-cycle	Calculate and record material life expiration (i.e., prepreg out time)	Able to determine working life and shelf life of materials
Employ continuous improvement processes	Describe why and how to use continuous improvement processes	Know how and willing to employ continuous improvement processes
Follow and meet production schedules	Meet production schedules	Understand work scheduling, forecasting, cycle time, lead time, critical path (critical path = longest lead time it takes to build a part)
Workplace skills/life skills	Demonstrate workplace skills/life skills	Shows up on time, ready to work, in proper dress...

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Performance Task	Performance Indicators	KSAs
Flexibility – producing different mixes or greater diversity of products quickly using a variety of job skills	Cross-trained	Knows many areas and skills sets
Recognize the direct cost of doing business	Explain the direct cost build up/flow in business	Understand the direct cost of being in business
Specify value in the eyes of the customer	Meets customer expectation	Knows what customer expectations are
Appreciate value stream	Identify the value stream	Know the purpose of the value stream
Achieve first-time quality	Meet all quality metrics	Know and understand quality production process (introduce six sigma)
Flexibility – perform multiple build processes	Self directed in charge of task and jobs	Know how to and be willing to perform a variety of task and jobs
Recommend change in processes	Helping make process revisions/suggestions	Knowledge of how to make suggestions for changes in processes
Performance metrics	Interpret performance metrics	Know how to interpret performance metrics

Introduction to Composites/Lab

Performance Task	Performance Indicators	KSAs
Work in the composites industry	Describe potential consumer products career opportunities in the composites industry	Knowledge of the composites industry and applications
Recognize products made from composite materials	Describe potential composites products and benefits	Knowledge of and processes selected for RTM, injection molding, filament winding, fiber placement, compression,
Distinguish between different	Identify RTM (resin transfer molding),	

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composite fabrication methods	injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, spray up, pultrusion, VARTM, extrusion, blow molding	bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, spray up, pultrusion, VARTM, extrusion, blow molding
Read process specification drawing and work order instructions	Explain data and details on process specification drawing and work order instructions	Knowledge and skills to read process specification drawing and work order instructions
Prepare polymer/resin mix per specifications; Weigh, measure, mix, and prepare chemicals and specimens per specifications	Follow the specifications to demonstrate correct polymer/resin mixing procedures	Ability to follow specifications and measure, mix polymers/resins, and additives. Read and understand vacuum and pressure gauges, and measuring devices. Understand tolerances. Know weight and measures and different ways of weighing. Read and understand manufacturer's product data. (glossary of terms)
Perform wet and prepreg lay-up	Demonstrate wet and prepreg lay-up and follow manufacturing plan	Knowledge of how to perform wet and prepreg lay-up and read a manufacturing plan
Identify basic tools	Describe do's and don'ts of basic tools Explain heat and pressures related to tooling	Knowledge of tooling considerations for each process Understanding of different properties of heat and pressure (use detailed examples in the curriculum)
Identify sources of parts damage in	Demonstrate proper handling	Knowledge of potential process and

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work area and recognize in process/handling damage	techniques	handling damage Knowledge of NDT (NDT = non-destructive testing) <i>(For instruction use photos of typical damage, defects, and causes)</i>
Identify basic composites lay-up tooling	Explains heat and pressure as related to tooling	Understanding of different properties of heat and pressure
Keeps shop area clean	Keeps a clean work area	Willingness to keep shop area clean "Clean as you go"
Perform minor repairs	Demonstrate minor repairs	Knowledge of repair procedures, heat lamps
Troubleshoot what went wrong	Resolve fabrication process errors	Know how to resolve fabrication process errors
Use different manufacturing methods	Perform RTM (resin transfer molding), injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, spray up, pultrusion, VARTM, extrusion, blow molding	Knowledge and skills to properly perform RTM (resin transfer molding), injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, spray up, pultrusion, VARTM, extrusion, blow molding
Determine proper surface prep and prepare materials for testing	Properly prepare test specimens	Know what the sample represents in relationship to part and the associated requirements Understand coupon, etc. terminology
Follow controlled environment procedures	Demonstrates proper procedures for working in a controlled environment	KSA to properly follow procedures for working in a controlled environment
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment

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Safety —Use specialized personal protective equipment (PPE)	Demonstrates use specialized personal protective equipment to meet OSHA standards	Knowledge, skills to don and use specialized personal protective equipment
Safety —Use appropriate lifting techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety —Use appropriate lifting materials and equipment	Demonstrates proper lifting materials and equipment in accordance with OSHA	Knowledge how to safely lift using materials and equipment
Safety —Use cutting tools properly	Demonstrates safe handling of cutting tools (i.e., razor or rotary blades)	Knows how to safely handle cutting tools (i.e., razor or rotary blades)
Safety —Wear appropriate harness equipment	Demonstrates properly wearing of harness equipment in accordance with OSHA	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with OSHA	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and air flow	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow
Safety —Safely uses chemicals and potentially hazardous substances	Demonstrates proper handling, use, storage, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, storage, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS
Safety —Seeks medical attention if	Demonstrates or explains when to seek	Knowledge potential physical reactions

experiencing a personal physical reaction immediately	and report medical attention if experiencing a personal physical reaction	to composite materials
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Composites Part Drawings

Performance Task	Performance Indicators	KSAs
Perform shop math functions	Demonstrates shop math	Knows and understands shop math including ratios, weights and measures (Teach core shop math)
Read and interpret decimal and fractional rule	Explain difference between decimal rule and functional rule	Understand the difference between and equivalence in decimal and imperial fractions (i.e., drill bit selection, tap and die selection, measurement, etc.)
Use hand measuring tools	Demonstrate proper selection and use of hand measurement tools	Knows weights and measures and how to read measuring tools (rulers, micrometers, scales, etc.)
Lay-up fiber orientation	Demonstrate correct ply orientation per specifications	Knows how to interpret rosette, prints, and specifications
Read 2-D vector based drawings	Demonstrate working knowledge on L and D vector drawings	Knowledge of how industry standards concerning composites are shown on an engineering drawing. Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail. Knowledge of dimensions and tolerances. Knows and understands a balanced laminate

Certificate Focused Capstone (Core)

Performance Task	Performance Indicators	KSAs
Fabricate a composite part	Fabricates and inspects a composite part	Starting with a tool/mold, KSA to fabricate a composite part and ensure a high level of quality control (<i>Inspire quality in class</i>) Consider bringing in a mold
Hole drilling, trimming and finishing parts to specifications	Properly drill, trim and finish parts according to specifications	Knowledge and skills to properly drill, trim and finish parts (finish = paint)
Assembles parts to specifications	Properly assembled part to specifications	Knowledge and skills to properly assemble parts (bonding - adhesives, bolting)
Maintains and cleans equipment and tools	Demonstrates basic equipment and tool maintenance and cleaning	Knowledge and willingness to maintain and clean equipment and tools
Keeps shop area clean	Keeps a clean work area	Willingness to keep shop area clean
Follows project instructions and drawings to manufacture and finish parts	Performs task following project instructions and drawings to manufacture and finish parts	Comprehension of project instructions and drawings to manufacture parts Understands tolerances Reads blueprints in English
Set up and conduct in process quality control test	In process quality control inspection using inspection hand tools	Know how to set up and conduct in process quality control using inspection hand tools (micrometer, dial caliper, measuring tape)
Weigh, measure, mix, mill, and prepare	Accurately scale materials according	Be able to weigh, measure, mix, mill,

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Performance Task	Performance Indicators	KSAs
chemicals and specimens per specifications	to specifications	and prepare chemicals and specimens per specifications Have understanding of calibration and method to dispense resins and catalyst
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment
Safety —Use specialized personal protective equipment (PPE)	Demonstrates use specialized personal protective equipment to meet OSHA standards	Knowledge, skills to don and use specialized personal protective equipment
Safety —Use appropriate lifting techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety —Use appropriate lifting materials and equipment	Demonstrates proper lifting materials and equipment in accordance with OSHA	Knowledge how to safely lift using materials and equipment
Safety —Use cutting tools properly	Demonstrates safe handling of cutting tools (i.e., razor or rotary blades)	Knows how to safely handle cutting tools (i.e., razor or rotary blades)
Safety —Wear appropriate harness equipment	Demonstrates properly wearing of harness equipment in accordance with OSHA	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures

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Performance Task	Performance Indicators	KSAs
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with OSHA	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and air flow	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow
Safety —Safely uses chemicals and potentially hazardous substances	Demonstrates proper handling, use, storage, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, storage, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS
Safety —Seeks medical attention if experiencing a personal physical reaction immediately	Demonstrates or explains when to seek and report medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials

Participant List

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Jose Anaya	Cerritos College	562-860-2451	janaya@cerritos.edu
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	CAM		
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Advanced Manufacturing Materials (Core Course)

Performance Task	Performance Indicators	KSAs
Opportunities in the composites industry	Describe potential career opportunities in the composites industry	Knowledge of the composites industry and applications Recognize potential allergic reactions some people have to composites and chemicals/know history of composites industry
Recognize manufacturing materials	Describe manufacturing materials – structure	Knowledge of polymers and reinforcements used in composites construction
Use materials and composites industry terminology	Define key materials and composite terms	Know and understand the key materials and composites industry terms
Identify specific applications for different composite materials	Describe different types of resins, reinforcements, and core materials	Knowledge of different types of resins, reinforcements, and core materials Knowledge of the different resins and their uses Knowledge of thermoset and thermoplastic
Determine correct materials per specifications	Distinguish between different materials and follow specs	Knowledge of the different materials, surface treatments, and their uses (noted very important)
Identify different fillers and additives per specifications	Distinguish between different fillers and additives and additives	Knowledge of the different fillers/additives, their properties and their uses
Proper storage and handling per specifications	Demonstrate proper storage and handling per specifications	Knowledge of the environmental effects on composite materials.

Performance Task	Performance Indicators	KSAs
		Knowledge of storage and handling—proper removal and log document out time and in time (<i>noted that this may be needed by only certain individuals</i>)
Determine proper tool and equipment prep	Ensure tool and equipment are clean, properly applied release, and prepped for lay-up	Know how to apply release agent and know what to use and how to clean tool and equipment
Select core materials per specifications	Distinguish between different core materials (i.e., honeycomb)	Knowledge of types and purposes of core materials
Identify specific applications per adhesive materials	Properly select adhesives per specific applications	Knowledge of specific adhesives and their applications (<i>noted quick overview for background</i>)
Safety —Safely uses and disposes of materials, chemicals, and potentially hazardous substances	Explain proper handling, use, and disposal of materials, chemicals, and potentially hazardous substances	Knowledge of proper handling, use, and disposal of materials, chemicals, and potentially hazardous substances
Safety —Identify various cleaning solvents (acetone, toluene, styrene, environmentally friendly solvents)	Demonstrates proper use of cleaning solvents	Knowledge of potential problems with using cleaning solvents
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS
Safety —Seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials

Enterprise Teaming (Core Course)

Performance Task	Performance Indicators	KSAs
Communicate and interact across culture	Describe different lines of communication	Know what others need to know and why they need to know it. Use interpersonal skills at multiple levels
Work as part of a manufacturing team	Define role as team members	Understand basics of team dynamics
Work with team to problem solve/Root cause analysis	Describe problem solving process	Know problem solving process
Focus on end-results	Starts with the end in mind	Able to visualize end product/results
SPC (SPC = Statistical Process Control)	Describe SPC process	Know and understand SPC methodologies (use case studies and real world practice in curriculum) <i>(noted to just touch on SPC)</i>
Team coach/mentor	Describe situations needing coaching and or mentoring	Knowledge of coaching and mentoring techniques
Listen to others	Demonstrates listening techniques	Knows and demonstrates listening techniques
Respect other team members ideas and suggestions	Demonstrates respect for others (Plays well with others)	Understand other peoples feelings and perspectives
Persuade others to visit concepts	Demonstrate persuading, selling, negotiating skills	Knows communication and negotiation skills
Interact in a union environment	Define their job and the role of the union and effects in a composites shop	Know the role of the union and effects in a composites shop
Takes responsibility for mistakes	Identifies mistakes	Understands the importance of identifying mistakes
Build consensus	Explain consensus building techniques	Knows consensus building techniques

Performance Task	Performance Indicators	KSAs
Ask questions	Use questioning techniques that lead to obtaining answers	Knows questioning techniques
Participates as a team member	Actively participates in a team	Knows what their part is in a team and how to share ideas
Deal with diversity	Works well with others	Knows how to interact with different personalities, characteristics, handicaps, diversities, etc.
Team Safety —Awareness of others around you and their tasks	Describes what other team members are doing as part of the team	Knows the positions and responsibilities of others

Manufacturing Economics (Core Course)

Performance Task	Performance Indicators	KSAs
Follow lean manufacturing practices	Demonstrate lean manufacturing practices including 5-S, Kaizen, pull-inventory, JIT inventory, Jidoka (constant quality checking)	Know lean manufacturing processes including TAKT time, manage/minimize waste (<i>noted that this should have a big emphasis</i>)
Understand the relationship between materials and fabrication costs	Identify the best materials and uses from an economic perspective (i.e. consumables)	Know relationship between basic business and fabrication costs
Use 5-S strategies/ 6-S (Safety)	Describes 5-S/6-S	Knows 5-S/6-S process and significance
Identify materials in relation to life-cycle	Calculate and record material life expiration (i.e., prepreg out time)	Able to determine working life and shelf life of materials
Employ continuous improvement processes	Describe why and how to use continuous improvement processes	Know how and willing to employ continuous improvement processes
Follow and meet production schedules	Meet production schedules	Understand work scheduling, forecasting, cycle time, lead time,

Performance Task	Performance Indicators	KSAs
		critical path (critical path = longest lead time it takes to build a part)
Workplace skills/life skills	Demonstrate workplace skills/life skills	Shows up on time, ready to work, in proper dress...
Flexibility - producing different mixes or greater diversity of products quickly using a variety of job skills	Cross-trained	Knows many areas and skills sets
Specify value in the eyes of the customer	Meets customer expectation	Knows what customer expectations are
Focus on each task that makes up a process	Sees and describes each task that makes up a process (identify what is)	Ability to see the overall process and identify value added verses non value added. Value added and what is not.
Map value stream	Maps the value stream	Know the purpose of the value stream
Achieve first-time quality	Meet all quality metrics	Know and understand quality production process (introduce six sigma)
Flexibility - perform multiple build processes	Self directed in charge of task and jobs	Know how to and be willing to perform a variety of task and jobs
Aid and help develop processes	Helping make completed revisions	Knowledge of how to make changes in development processes including: planning and controlling documents
Performance metrics	Define key performance metrics	Know how to interpret performance metrics

Introduction to Composites/Lab

Performance Task	Performance Indicators	KSAs
Work in the composites industry	Describe potential consumer products career opportunities in the composites industry	Knowledge of the composites industry and applications
Recognize products made from composite materials	Describe potential composites products and benefits	Knows applications of different composite processes
Distinguish between different fiber lay-up methods	Identify RTM (resin transfer molding), injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, pultrusion, thermoplastics infusion	Knowledge of and processes selected for RTM, injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, pultrusion, thermoplastics infusion
Read process specification drawing and work order instructions	Explain data and details on process specification drawing and work order instructions	Knowledge and skills to read process specification drawing and work order instructions
Bonding and joining parts	Properly prepares, bonds, and joins parts	Knowledge of mechanical, chemical, and environmental impact on bonds and joints
Prepare polymer/resin mix per specifications; Weigh, measure, mix, and prepare chemicals and specimens per specifications	Follow the specifications to demonstrate correct polymer/resin mixing procedures	Ability to follow specifications and measure, mix polymers/resins and additives. Read and understand pressure gauges and measuring devices. Understand tolerances. Understand chemical reactions
Prepare Finishes, (gel-coat, paint dips, etc...)	Demonstrates use of finishes (gel-coat, paint dips, etc...)	Knows how to prepare finishes (gel-coat, paint dips, etc...)
Perform hand lay-up (prepreg vs.	Demonstrate hand lay-up and follow	Knowledge of how to perform hand

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wet)	drawings and specifications	lay-up and read follow a drawings and specifications
Identify basic tools	Describe do's and don'ts of basic tools Explain heat and pressures related to tooling	Knowledge of tooling considerations for each process Understanding of different properties of heat and pressure (use detailed examples in the curriculum) Knows why it is beneficial to select a male, female, or multiple piece tool.
Properly store, handle use, and dispose of cleaning solvents	Demonstrate how to properly store, handle, use, and dispose of cleaning solvents	Knows how to properly store, handle, use, and dispose of cleaning solvents
Identify sources of parts damage in work area and recognize in process/handling damage	Demonstrate proper handling techniques	Knowledge of potential process and handling damage Knowledge of NDT (NTD = non-destructive testing) <i>(For instruction use photos of typical damage, defects, and causes)</i>
Apply release agents (internal and external)	Properly applies release agents (internal and external)	Knows how to properly apply release agents (internal and external)
Identify basic composites lay-up tooling	Explains heat and pressure as related to tooling	Understanding of different properties of heat and pressure
Keeps shop area clean	Keeps a clean work area	Willingness to keep shop area clean
Perform repairs	Demonstrate successful repair	Knowledge of repair procedures, heat lamps
Prepare fasteners and adhesives	Repairs using fasteners and adhesives	Knowledge of how to prepare fasteners and adhesives
Use different manufacturing methods	Perform RTM (resin transfer molding), injection molding, filament winding,	Knowledge and skills to properly perform RTM (resin transfer molding),

	fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, pultrusion, thermoplastics infusion	injection molding, filament winding, fiber placement, compression, bag molding, thermoforming, wet lay-up, roto-molding, tape/fiber placement, pultrusion, thermoplastics infusion
Determine proper surface prep and prepare materials for testing	Properly prepare test specimens	Know what the sample represents in relationship to part and the associated requirements
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment
Safety --Use, store and care for appropriate personal protective equipment (PPE)	Demonstrates use, storing and caring for appropriate personal protective equipment to meet OSHA standards	Knowledge, skills and willingness to don and use, store and care for appropriate personal protective equipment
Safety --Use appropriate lifting techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety --Wear appropriate harness equipment	Demonstrates properly wearing of harness equipment in accordance with OSHA	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with OSHA	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and air flow	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow

Safety —Safely uses chemicals and potentially hazardous substances	Demonstrates proper handling, use, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data Safety Sheets) properly	Demonstrates proper use of MSDS	Knowledge and skills to read and properly follow MSDS
Safety —Seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek and report medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials
Safety —Properly store, handle, use, and dispose of hazardous waste	Properly stores, handles, uses and disposes of hazardous waste to meet EPA specifications	Knowledge of hazardous waste disposal and EPA regulations, Department of Ecology, related to air quality, liquid and solid hazardous waste disposal

Composites Part Drawings

Performance Task	Performance Indicators	KSAs
Lay-up fiber orientation	Demonstrate correct fiber orientation per specifications	Knows how to interpret rosette, prints, and specifications
Read 2-D vector based drawings	Demonstrate working knowledge on L and D vector drawings	Knowledge of how industry standards concerning composites are shown on an engineering drawing. Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail. Knowledge of dimensions and tolerances.
Read 3-D solid and surface models	Read and interpret 3-D drawings	Knowledge of how industry standards concerning composites are

Performance Task	Performance Indicators	KSAs
		<p>shown on a 3-D model as well as on an engineering drawing. Knowledge about parts, assemblies, and engineering drawing, and knowledge about how these are inter-related. Knowledge of orthographic drawing views: front, top, side, auxiliary, section and detail. Knowledge of dimensions and tolerances. (Introduce software views in CATIA, Solidworks, Pro-E, AutoCAD, Master CAM, Unigraphics in curriculum)</p>
Read both metric and imperial system scales	Properly reads both metric and imperial system scales	Knowledge and ability to read both metric and imperial system scales
Make ruler measurements and calculations	Properly make ruler measurements and calculations	Knowledge and ability to make ruler measurements and calculations

Certificate Focused Capstone (Core)

Performance Task	Performance Indicators	KSAs
Fabricate a composite part	Fabricates and inspects a composite part	KSA to fabricate a composite part and ensure a high level of quality control <i>(Inspire quality in class)</i>
Hole drilling, trimming and finishing parts to specifications	Properly drill, trim and finish parts according to specifications	Knowledge and skills to properly drill, trim and finish parts (finish = paint)
Assembles parts to specifications	Properly assembled part to specifications	Knowledge and skills to properly prepare and assemble parts (surface prep, bonding – adhesives, bolting)
Maintains and cleans equipment and tools	Demonstrates basic equipment and tool maintenance and cleaning	Knowledge and willingness to maintain and clean equipment and tools
Keeps shop area clean	Keeps a clean work area	Willingness to keep shop area clean
Follows project instructions and <u>blueprints/drawings</u> to manufacture and finish parts	Performs task following project instructions and blueprints/drawings to manufacture and finish parts	Comprehension of project instructions and blueprints/drawings to manufacture parts Understands tolerancing Reads blueprints in English language
Follows project instructions and blueprints/drawings to lay-up test specimens	Lay-up test specimens per specifications	Knowledge and skills to lay-up test specimens according to the specifications
Set up and conduct in process quality control test	In process quality control inspection using inspection hand tools	Know how to set up and conduct in process quality control using inspection hand tools
Weigh, measure, mix, mill, and prepare chemicals and specimens per	Accurately scale materials according to specifications	Be able to weigh, measure, mix, mill, and prepare chemicals and specimens

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Performance Task	Performance Indicators	KSAs
specifications		per specifications
Safety —Wear proper clothing per work environment	Demonstrate wearing proper clothing for the work environment	Knowledge and willingness to wear proper clothing for the work environment
Safety —Use, store and care for appropriate personal protective equipment (PPE)	Demonstrates use, storing and caring for appropriate personal protective equipment to meet OSHA standards	Knowledge, skills and willingness to don and use, store and care for appropriate personal protective equipment
Safety —Use appropriate lifting techniques	Demonstrates proper lifting techniques in accordance with OSHA	Knowledge and skills to safely lift items
Safety —Wear appropriate harness equipment	Demonstrates properly wearing of harness equipment in accordance with OSHA	Knowledge and skills to properly don appropriate harness equipment
Safety —Set up and maintain safe work area	Demonstrates setting up and maintaining safe work area in accordance with OSHA	Knowledge of safe work areas
Safety —Use lock out/tag out procedures	Demonstrates proper lock out /tag out procedures in accordance with OSHA	Knowledge of lock out/tag out procedures
Safety —Use buddy system where required	Demonstrates using buddy system where required in accordance with OSHA	Knowledge of when and how to use the buddy system for safety.
Safety —Monitor breathing zones and air flow	Demonstrates proper methods to monitor breathing zones and air flow	Knowledge of monitoring breathing zones and air flow
Safety —Safely uses chemicals and potentially hazardous substances	Demonstrates proper handling, use, and disposal of chemicals and potentially hazardous substances	Knowledge of proper handling, use, and disposal of chemicals and potentially hazardous substances
Safety —Uses MSDS (Material Data	Demonstrates proper use of MSDS	Knowledge and skills to read and

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Performance Task	Performance Indicators	KSAs
Safety Sheets) properly		properly follow MSDS
Safety —Seeks medical attention if experiencing a personal physical reaction	Demonstrates or explains when to seek and report medical attention if experiencing a personal physical reaction	Knowledge potential physical reactions to composite materials
Safety —Properly store, handle, use, and dispose of hazardous waste	Properly stores, handles, uses and disposes of hazardous waste to meet EPA specifications	Knowledge of hazardous waste disposal and EPA regulations, Department of Ecology, related to air quality, liquid and solid hazardous waste disposal

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