Nanotechnology Technician Skill Standards



Critical Work Function	Key Activity	Key Activity	Key Activity	Key Activity	Key Activity
1. Build Nanotechnology Systems (such as probing systems and nanolithography systems)	1.1 Prepare parts for in-house assembly of system	1.2 Build subsystems for in-house assembly of complete system	1.3 Test subsystem components in house	1.4 Assemble system in house	
2. Install Nanotechnology Systems (such as probing systems and nanolithography systems)	2.1 Prepare parts for on-site assembly of system	2.2 Build subsystems for onsite assembly of complete system	2.3 Test subsystem components on site	2.4 Assemble and install system on site	
3. Maintain and Repair Nanotechnology Equipment (such as probing systems and nanolithography systems)	3.1 Perform preventive maintenance	3.2 Diagnose malfunctions	3.3 Repair malfunctions		
4. Support Nano-scale Product Development (such as semiconductor device fabrication or integrating nano- materials into a variety of customer applications)	4.1 Characterize nano-scale materials	4.2 Perform incoming quality control	4.3 Perform product research	4.4 Design prototypes	4.5 Evaluate prototypes
5. Manufacture Nano-scale Product (such as semiconductor device fabrication or integrating nano- materials into a variety of customer applications)	5.1 Control environment	5.2 Operate manufacturing equipment	5.3 Operate test equipment		

Occupational Title:	Nanotechnology Technician						
Critical Work Funct	tion 1. Build Nanotechnology Systems	Occupational Skills, Knowledge & Conditions					
Кеу	Performance Criteria	Occupational Skills & Knowledge	Conditions				
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?				
1.1 Prepare parts for in-house assembly of system	 1.1.1 Preparation meets procedural requirements including verification of customer requirements, adequate process planning and review of assembly drawings 1.1.2 Parts appropriate to the system being assembled are selected for use 1.1.3 Materials appropriate to the system being assembled are selected for use 	Understanding the importance of variance reporting Mechanical precision to the nano scale Volumetric measurement to the nano scale Crystallography and metallurgy Toughness, strength, and ductility of materials Use of measuring instruments and tools Unit conversion Ability to read mechanical drawings Understanding of industry reference materials Understanding of ISO 9000 Understanding of geometric dimensions and tolerances Knowledge of HAZMAT procedures	Semiconductor manufacturing equipment Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Lab equipment (materials testing, etc.)				

Occupational Title:	Nanotechnology Technician				
Critical Work Func	tion 1. Build Nanotechnology Systems	Occupational Skills, Kno	owledge & Conditions		
Key Activity	Performance Criteria How do we know when the key activity is performed well or performed successfully?	Occupational Skills & Knowledge What should the technician know and what skills should the technician have in order to do the activity?	Conditions What tools must the technician use in order to do the activity?		
1.2 Build subsystems for in- house assembly of complete system	 1.2.1 Subsystems are assembled and integrated according to specifications 1.2.2 Tools appropriate to the system or subsystem being assembled and integrated are selected for use. 1.2.3 Tools are used according to established procedures 	Understanding the importance of variance reporting Semiconductor manufacturing processes High precision electrical measurements Crystallography and metallurgy Toughness, strength and ductility of materials Microscopy and spectroscopy Use of measuring instruments and tools Unit conversion Ability to use vacuum systems Ability to gauge repeatability and reproducibility Ability to read mechanical drawings Understanding of industry reference materials Understanding of ISO 9000 Understanding of geometric dimensions and tolerances Knowledge of HAZMAT procedures	Advanced optical microscopes Semiconductor manufacturing equipment Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Oscilloscope Voltmeter Microbalance Instrument interface software Personal protective equipment		

Occupational Title	: Nanotechnology Technician		
Critical Work Fund	ction 1. Build Nanotechnology Systems	Occupational Skills, Kno	owledge & Conditions
Key	Performance Criteria	Occupational Skills & Knowledge	Conditions
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?
1.3 Test subsystem components in house	1.3.1 Tests verify system components are operating properly1.3.2 Test results are properly documented1.3.3 Non-conforming product is properly quarantined	Understanding of the importance of variance reporting Volumetric measurement to the nano scale High precision electrical measurements Crystallography and metallurgy Toughness, strength, and ductility of materials Microscopy and spectroscopy Use of measuring instruments and tools Nano scale metrology Unit conversion Ability to use vacuum systems Ability to gauge repeatability and reproducibility Ability to read mechanical drawings Understanding of industry reference materials	Advanced optical microscopes Scanning probe microscopes Thin-film measurement equipment: profilometers and ellipsometers to the nano scale Spectrophotometer Laser interferometer Computer software (word processing, spreadsheet, database, presentation, email, etc.) Lab equipment Oscilloscope Voltmeter Microbalance Frequency generator Instrument interface software Personal protective equipment
		Understanding of ISO 9000 Understanding of geometric dimensions and tolerances	
1.4 Assemble system in house	1.4.1 Testing verifies proper operation of system components, integration of control systems, and the operation of the system interface	Understanding of the importance of variance reporting Unit conversion	Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks
	1.4.2 Assembled system meets manufacturer performance specifications	Ability to read mechanical drawings Understanding of ISO 9000	Lab equipment (materials testing, etc.) Instrument interface software
	1.4.3 Customer acceptance is documented according to company procedure	Understanding of geometric dimensions and tolerances	Personal protective equipment
	1.4.4 Post-delivery support is provided according to procedure		

Academic and Employability Knowledge and Skill Matrix for Critical Work Function 1: Build Nanotechnology Systems

On a scale of 1 (lowest) to 5 (highest), identify the level of complexity required in each of these skills for the worker to perform the critical work function. Keep in mind that this scale is not for rating an individual's proficiency. It is intended only for rating the level of complexity required to do the work.

Occupa	Occupational Title: Nanotechnology Technician															
CWF 1	CWF 1 Build Nanotechnology Systems															
Listening	Speaking	Information and Communication		Solving	Decisions and		Using Social Skills	Adaptability	Working in Teams		Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
3	3	3	4	4	4	4	3	3	4	4	3	3	2	4	3	3

Statement of Assessment for Critical Work Function 1: Build Nanotechnology Systems

The statements of assessment can do any of several things:

- Define tools or strategies that industry could use to assess the level of competency a worker has attained in a particular critical work function.
- Define for trainers and educators how to assess the level of competency a student has attained relevant to the critical work function.
- Define the level of mastery of the critical work function that indicates that a worker or student has achieved an entry-, intermediate-, or advanced level of mastery of a critical work function.

A. Tests could include:

- 1) Multiple choice and essay questions that demonstrate an understanding of knowledge being assessed.
- 2) Preparation and justification of a reasonable solution to a problem scenario.
- B. Hands-on exercises or simulations to demonstrate acquisition of knowledge and skills that could:
 - 1) Apply relevant knowledge or skills
 - 2) Focus on the application of knowledge and skills to a new situation
 - 3) Demonstrate an ability to plan, organize, and create a product, service, or an event.
 - 4) Illustrate by individual performance the attained levels of knowledge and skills.
 - 5) Include observation of events, groups, and individuals that focuses on the relevant traits of the skill in question

Occupational Title:	Occupational Title: Nanotechnology Technician						
Critical Work Functi	on 2. Install Nanotechnology Systems	Occupational Skills, Knowledge & Conditions					
Key	Performance Criteria	Occupational Skills & Knowledge Cond					
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?				
2.1 Prepare parts for on-site	2.1.1 Preparation meets procedural requirements including verification of customer requirements,	Understand the importance of variance reporting	Computer software (word processing, spreadsheet, database, presentation,				
assembly of system	adequate process planning and review of assembly	Semiconductor manufacturing	email, etc.)				
	drawings	processes	Reference handbooks				
	2.1.2 Parts appropriate to the system being assembled are selected for use	High precision electrical measurements	Lab equipment (materials testing, etc.)				
	2.1.3 Site survey is complete, indicates site is	Crystallography and metallurgy	Instrument interface software				
	appropriate for installation	Toughness, strength, and ductility of materials	Personal protective equipment				
	2.1.4 Site preparation is complete for installation	Use of measuring instruments and tools					
		Unit conversion					
		Ability to read mechanical drawings					
		Understanding of industry reference materials					
		Understanding of ISO 9000					
		Understanding of geometric dimensions and tolerances					
		Knowledge of HAZMAT procedures					

Occupational Title:	Nanotechnology Technician					
Critical Work Funct	ion 2. Install Nanotechnology Systems	Occupational Skills, Knowledge & Conditions				
Кеу	Performance Criteria	Occupational Skills & Knowledge	Conditions			
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?			
2.2 Build subsystems for onsite assembly of complete system	 2.2.1 Subsystems are assembled and integrated according to specifications 2.2.2 Tools appropriate to the system or subsystem being assembled and integrated are selected for use. 2.2.3 Tools are used according to established procedures 	Understand the importance of variance reporting High precision electrical measurements Use of measuring instruments and tools Unit conversion Ability to gauge repeatability and reproducibility Ability to read mechanical drawings Understanding of industry reference materials Understanding of ISO 9000 Understanding of geometric dimensions and tolerances	Advanced optical microscopes Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Lab equipment Oscilloscope Voltmeter Instrument interface software Personal protective equipment			
		Knowledge of HAZMAT procedures				

Occupational Title:	Nanotechnology Technician	_	
Critical Work Functi	on 2. Install Nanotechnology Systems	Occupational Skills, K	nowledge & Conditions
Кеу	Performance Criteria	Occupational Skills & Knowledge	Conditions
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?
2.3 Test subsystem components on site	2.3.1 Tests verify system components are operating properly	Understanding of statistical process control	Advanced optical microscopes
components on site		Understanding the importance of	Scanning probe microscopes
	2.3.2 Test results are properly documented	variance reporting	Thin-film measurement equipment
	2.3.3 Non-conforming product is repaired or replaced	Mechanical precision to the nano scale	Spectrophotometer
		High precision electrical	Laser interferometer
		measurements	Computer software (word processing,
		Microscopy and spectroscopy	spreadsheet, database, presentation, email, etc.)
		Use of measuring instruments and tools	Reference handbooks
		Nano scale metrology	Lab equipment
		Unit conversion	Oscilloscope
		Ability to use vacuum systems	Voltmeter
		Ability to gauge repeatability and	
		reproducibility Ability to read mechanical drawings	Frequency generator
		Understanding of industry reference	Instrument interface software
		materials	Personal protective equipment
		Understanding of ISO 9000	
		Understanding of geometric dimensions and tolerances	
		Knowledge of HAZMAT procedures	

Occupational Title:	Occupational Title: Nanotechnology Technician							
Critical Work Funct	ion 2. Install Nanotechnology Systems	Occupational Skills, Knowledge & Conditions						
Key	Performance Criteria	Occupational Skills & Knowledge	Conditions					
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?					
2.4 Assemble and install system on	2.4.1 Testing verifies proper operation of system components, integration of control systems, and the	Understanding the importance of variance reporting	Computer software (word processing, spreadsheet, database, presentation,					
site	operation of the system interface	Use of measuring instruments and	email, etc.)					
	2.4.2 Assembled and installed system meets	tools	Reference handbooks					
	manufacturer specifications	Unit conversion	Lab equipment					
	2.4.3 Customer acceptance of the installed system is	Ability to read mechanical drawings						
	documented according to company procedure	Understanding of industry reference	Instrument interface software					
		materials	Personal protective equipment					
		Understanding of ISO 9000						
		Understanding of geometric dimensions and tolerances						
		Knowledge of HAZMAT procedures						

Academic and Employability Knowledge and Skill Matrix for Critical Work Function 2: Install Nanotechnology Systems

On a scale of 1 (lowest) to 5 (highest), identify the level of complexity required in each of these skills for the worker to perform the critical work function. Keep in mind that this scale is not for rating an individual's proficiency. It is intended only for rating the level of complexity required to do the work.

Occupa	Occupational Title: Nanotechnology Technician															
CWF 2	CWF 2 Install Nanotechnology Systems															
Listening	Speaking	Information and Communication	and	Solving	Decisions and	and Planning	Using Social Skills	Adaptability	Working in Teams	Leading Others	Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
4	4	4	3	4	4	4	4	4	4	4	4	3	3	4	4	3

Statement of Assessment for Critical Work Function 2: Install Nanotechnology Systems

The statements of assessment can do any of several things:

- Define tools or strategies that industry could use to assess the level of competency a worker has attained in a particular critical work function.
- Define for trainers and educators how to assess the level of competency a student has attained relevant to the critical work function.
- Define the level of mastery of the critical work function that indicates that a worker or student has achieved an entry-, intermediate-, or advanced level of mastery of a critical work function.

A. Tests could include:

- 1) Multiple choice and essay questions that demonstrate an understanding of knowledge being assessed.
- 2) Preparation and justification of a reasonable solution to a problem scenario.
- B. Hands-on exercises or simulations to demonstrate acquisition of knowledge and skills that could:
 - 1) Apply relevant knowledge or skills
 - 2) Focus on the application of knowledge and skills to a new situation
 - 3) Demonstrate an ability to plan, organize, and create a product, service, or an event.
 - 4) Illustrate by individual performance the attained levels of knowledge and skills
 - 5) Include observation of events, groups, and individuals that focuses on the relevant traits of the skill in question

Occupational Titl	e: Nanotechnology Technician						
Critical Work Fur Equipment	ction 3. Maintain and Repair Nanotechnology	Occupational Skills, Knowledge & Conditions					
Кеу	Performance Criteria	Performance Criteria Occupational Skills & Knowledge					
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?				
3.1 Perform preventive	3.1.1 Maintenance record meets preventive	Understanding the importance of variance reporting	Advanced optical microscopes				
maintenance	maintenance (PM) program requirements for timeliness and frequency as required by	Semiconductor manufacturing processes	Scanning probe microscopes				
	manufacturer specification.	Volumetric measurement to the nano scale	Thin-film measurement equipment				
		High precision electrical measurements	Computer software (word				
	3.1.2 Maintenance record is complete and current	Crystallography and metallurgy	processing, spreadsheet, database, presentation, email, etc.)				
		Toughness, strength, and ductility of materials					
		Microscopy and spectroscopy	Reference handbooks				
		Use of measuring instruments and tools	Lab equipment				
		Ability to use vacuum systems	Oscilloscope				
		Ability to gauge repeatability and reproducibility	Voltmeter				
		Ability to read mechanical drawings	Microbalance				
		Understanding of industry reference materials					
		Understanding of ISO 9000	Frequency generator				
		Understanding of geometric dimensions and	Instrument interface software				
		tolerances	Personal protective equipment				
		Knowledge of HAZMAT procedures					

	e: Nanotechnology Technician action 3. Maintain and Repair Nanotechnology	Occupational Skills, Knowl	edge & Conditions		
Equipment					
Кеу	Performance Criteria	Occupational Skills & Knowledge	Conditions		
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?		
3.2 Diagnose malfunctions	3.2.1 Tests are performed in attempt to duplicate problem with results documented	Understanding the importance of variance reporting	Advanced optical microscopes Scanning probe microscopes		
	3.2.2 Anomalies are accurately characterized and	Mechanical precision to the nano scale			
	documented	High precision electrical measurements	Thin-film measurement equipment		
	3.2.3 Malfunction is identified and recorded	Microscopy and spectroscopy	Spectrophotometer		
		Use of measuring instruments and tools	Laser interferometer		
		Unit conversion	X-ray (fluorescence and diffraction)		
		Ability to use vacuum systems	Computer software (word		
		Ability to gauge repeatability and reproducibility	processing, spreadsheet, database,		
		Ability to read mechanical drawings	presentation, email, etc.)		
		Understanding of industry reference materials	Reference handbooks		
		Understanding of geometric dimensions and	Lab equipment		
		tolerances	Oscilloscope		
			Voltmeter		
			Microbalance		
			Frequency generator		
			Instrument interface software		
			Personal protective equipment		

Critical Work Fur Equipment	nction 3. Maintain and Repair Nanotechnology	Occupational Skills, Knowle	edge & Conditions
Key	Performance Criteria	Occupational Skills & Knowledge	Conditions
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?
3.3 Repair malfunctions	3.3.1 Appropriate tools are selected for the repair	Understanding the importance of variance reporting	Computer software (word processing, spreadsheet, database,
	3.3.2 Repairs are resolved per manufacturer specification	Mechanical precision to the nano scale	presentation, email, etc.)
	3.3.3 Service report is prepared for customer	Volumetric measurement to the nano scale	Reference handbooks
	according to policy	High precision electrical measurements	Lab equipment
	3.3.4 Maintenance record is complete and current	Crystallography and metallurgy	Oscilloscope
	·	Toughness, strength, and ductility of materials	Voltmeter
		Microscopy and spectroscopy	Instrument interface software
		Use of measuring instruments and tools	Personal protective equipment
		Toughness, strength, and ductility of materials Microscopy and spectroscopy	
		Unit conversion	
		Ability to use vacuum systems	
		Ability to gauge repeatability and reproducibility	
		Ability to read mechanical drawings	
		Understanding of ISO 9000	
		Understanding of geometric dimensions and tolerances	
		Knowledge of HAZMAT procedures	

Academic and Employability Knowledge and Skill Matrix for Critical Work Function 3: Maintain and Repair Nanotechnology Equipment

On a scale of 1 (lowest) to 5 (highest), identify the level of complexity required in each of these skills for the worker to perform the critical work function. Keep in mind that this scale is not for rating an individual's proficiency. It is intended only for rating the level of complexity required to do the work.

Occupa	ational Ti	tle: Nanotechi	nology Tecl	hnician												
CWF 3	CWF 3 Maintain and Repair Nanotechnology Equipment															
Listening		Using Information and Communication Technology	and	Analyzing and Solving Problems	Decisions and		Using Social Skills	Adaptability	Working in Teams	Leading Others	Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
3	3	3	4	5	4	4	4	4	4	4	4	3	3	4	4	4

Statement of Assessment for Critical Work Function 3: Maintain and Repair Nanotechnology Equipment

The statements of assessment can do any of several things:

- Define tools or strategies that industry could use to assess the level of competency a worker has attained in a particular critical work function.
- Define for trainers and educators how to assess the level of competency a student has attained relevant to the critical work function.
- Define the level of mastery of the critical work function that indicates that a worker or student has achieved an entry-, intermediate-, or advanced level of mastery of a critical work function.

A. Tests could include:

- 1) Multiple choice and essay questions that demonstrate an understanding of knowledge being assessed.
- 2) Preparation and justification of a reasonable solution to a problem scenario.
- B. Hands-on exercises or simulations to demonstrate acquisition of knowledge and skills that could:
 - 1) Apply relevant knowledge or skills
 - 2) Focus on the application of knowledge and skills to a new situation
 - 3) Demonstrate an ability to plan, organize, and create a product, service, or an event.
 - 4) Illustrate by individual performance the attained levels of knowledge and skills
 - 5) Include observation of events, groups, and individuals that focuses on the relevant traits of the skill in question

Occupational Title	: Nanotechnology Technician		
Critical Work Fund Development	tion 4. Support Nano-scale Product	Occupational Skills, Knowle	dge & Conditions
Кеу	Performance Criteria	Occupational Skills & Knowledge	Conditions
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?
4.1 Characterize	4.1.1 Sample is appropriately prepared for	Understanding of statistical process control	Advanced optical microscopes
nano-scale	processing	Understanding the importance of variance reporting	Scanning probe microscopes
materials	4.1.2 Sample data is collected, analyzed, and	Understanding of statistical process control Understanding the importance of variance reporting Mechanical precision to the nano scale Volumetric measurement to the nano scale High precision electrical measurements Crystallography and metallurgy Toughness, strength, and ductility of materials Microscopy and spectroscopy Familiarity with quantum effects Use of measuring instruments and tools	Semiconductor manufacturing equipment
	results are documented as required by procedure	Volumetric measurement to the nano scale	Thin-film measurement equipment
		High precision electrical measurements	Spectrophotometer
	4.1.3 Statistical process control is developed as required	Crystallography and metallurgy	Laser interferometer
	4.1.4 Data anomalies are characterized and	Toughness, strength, and ductility of materials	X-ray (fluorescence and diffraction)
	accurately documented	Microscopy and spectroscopy	Computer software (word processing,
	4.1.5 Analysis findings are reported and	Familiarity with quantum effects	spreadsheet, database, presentation,
	documented according to procedure	Use of measuring instruments and tools	email, etc.)
		Nano scale metrology	Reference handbooks
		Unit conversion	Lab equipment Voltmeter
		Ability to use vacuum systems	Microbalance
		Ability to gauge repeatability and reproducibility	Instrument interface software
		Understanding of industry reference materials	Personal protective equipment
		Understanding of ISO 9000	F
		Understanding of geometric dimensions and tolerances	
		Knowledge of HAZMAT procedures	

Critical Work Fund Development	tion 4. Support Nano-scale Product	Occupational Skills, Knowle	dge & Conditions
Key Activity	Performance Criteria How do we know when the key activity is performed	Occupational Skills & Knowledge What should the technician know and what skills should	Conditions What tools must the technician use in order
4.2 Perform incoming quality control	well or performed successfully? 4.2.1 Supplier approval is verified with proper documentation 4.2.2 Document audit is conducted and verifies that material meets specifications 4.2.3 Sampling verifies material meets specifications specifications	the technician have in order to do the activity? Understanding of statistical process control Understanding the importance of variance reporting Mechanical precision to the nano scale Volumetric measurement to the nano scale High precision electrical measurements Crystallography and metallurgy Toughness strength and ductility of materials Microscopy and spectroscopy Use of measuring instruments and tools Nano scale metrology Unit conversion Ability to gauge repeatability and reproducibility Understanding of industry reference materials Understanding of ISO 9000 Understanding of geometric dimensions and tolerances Knowledge of HAZMAT procedures	to do the activity? Advanced optical microscopes Scanning probe microscopes Thin-film measurement equipment Spectrophotometer X-ray Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Lab equipment Oscilloscope Voltmeter Microbalance Personal protective equipment

Critical Work Fund Development	tion 4. Support Nano-scale Product	Occupational Skills, Knowledge & Conditions								
Key Activity	Key Performance Criteria Activity How do we know when the key activity is performed successfully? Perform 4.3.1 Product under development meets	Occupational Skills & Knowledge What should the technician know and what skills should the technician have in order to do the activity?	Conditions What tools must the technician use in order to do the activity?							
4.3 Perform product research	 4.3.1 Product under development meets customer needs or specifications 4.3.2 Research results appropriately documented from start of research to finish, including full analysis of failures 	Semiconductor manufacturing processes Crystallography and metallurgy Toughness, strength, and ductility of materials Familiarity with quantum effects Unit conversion Understanding of industry reference materials Understanding of geometric dimensions and tolerances Knowledge of HAZMAT procedures	Advanced optical microscopes Scanning probe microscopes Thin-film measurement equipment Spectrophotometer X-ray Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Lab equipment Microbalance Instrument interface software Personal protective equipment							

Occupational Tit	le: Nanotechnology Technician								
Critical Work Fur Development	nction 4. Support Nano-scale Product	Occupational Skills, Knowle	dge & Conditions						
Кеу	Performance Criteria	Performance Criteria Occupational Skills & Knowledge							
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?						
4.4 Design	4.4.1 Customer requirements are clarified and	Understanding of design of experiments	Computer software (word processing,						
prototypes	documented, as appropriate	Understanding the importance of variance reporting	spreadsheet, database, presentation, email, etc.)						
	4.4.2 Prototype performs to expectation and	Semiconductor manufacturing processes	Reference handbooks						
	specification	Mechanical precision to the nano scale	Instrument interface software						
		Volumetric measurement to the nano scale							
		High precision electrical measurements							
		Crystallography and metallurgy							
		Toughness, strength, and ductility of materials							
		Microscopy and spectroscopy							
		Familiarity with quantum effects							
		Use of measuring instruments and tools							
		Nano scale metrology							
		Unit conversion							
		Ability to use vacuum systems							
		Ability to gauge repeatability and reproducibility							
		Ability to read mechanical drawings							
		Understanding of industry reference materials							
		Understanding of ISO 9000							
		Understanding of geometric tolerances							
		Knowledge of HAZMAT procedures							

Occupational Titl	e: Nanotechnology Technician								
Critical Work Fur Development	ction 4. Support Nano-scale Product	Occupational Skills, Knowle	dge & Conditions						
Key	Performance Criteria	Performance Criteria Occupational Skills & Knowledge							
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?						
4.5 Evaluate	4.5.1 Evaluation findings are reported and	Understanding of design of experiments	Advanced optical microscopes						
prototypes	documented according to procedure	Understanding the importance of variance reporting	Scanning probe microscopes						
	4.5.2 Appropriate analytical equipment is	Semiconductor manufacturing processes	Thin-film measurement equipment						
	selected for the task	Mechanical precision to the nano scale	Spectrophotometer						
	4.5.3 Prototype performs to expectation and	High precision electrical measurements	Laser interferometer						
	specification	Crystallography and metallurgy	X-ray						
		Toughness, strength, and ductility of materials	Computer software (word processing, spreadsheet, database, presentation,						
		Microscopy and spectroscopy	email, etc.)						
		Familiarity with quantum effects	Lab equipment						
		Use of measuring instruments and tools	Oscilloscope						
		Nano scale metrology	Voltmeter						
		Unit conversion	Microbalance						
		Ability to use vacuum systems	Frequency generator						
		Ability to gauge repeatability and reproducibility	Instrument interface software						
		Ability to read mechanical drawings	Personal protective equipment						
		Understanding of industry reference materials							
		Understanding of ISO 9000							
		Understanding of geometric dimensions and tolerances							
		Knowledge of HAZMAT procedures							

Academic and Employability Knowledge and Skill Matrix for Critical Work Function 4: Support Nano-scale Product Development

On a scale of 1 (lowest) to 5 (highest), identify the level of complexity required in each of these skills for the worker to perform the critical work function. Keep in mind that this scale is not for rating an individual's proficiency. It is intended only for rating the level of complexity required to do the work.

Occupa	ational Ti	itle: Nanotechr	nology Tec	hnician												
CWF 4	CWF 4 Support Nano-scale Product Development															
Listening	Speaking	Information and Communication		Solving	Decisions and		Using Social Skills	Adaptability	Working in Teams		Building Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
4	4	3	4	5	4	3	3	4	4	4	4	3	4	4	4	5

Statement of Assessment for Critical Work Function 4: Support Nano-scale Product Development

The statements of assessment can do any of several things:

- Define tools or strategies that industry could use to assess the level of competency a worker has attained in a particular critical work function.
- Define for trainers and educators how to assess the level of competency a student has attained relevant to the critical work function.
- Define the level of mastery of the critical work function that indicates that a worker or student has achieved an entry-, intermediate-, or advanced level of mastery of a critical work function.

A. Tests could include:

- 1) Multiple choice and essay questions that demonstrate an understanding of knowledge being assessed.
- 2) Preparation and justification of a reasonable solution to a problem scenario.
- B. Hands-on exercises or simulations to demonstrate acquisition of knowledge and skills that could:
 - 1) Apply relevant knowledge or skills
 - 2) Focus on the application of knowledge and skills to a new situation
 - 3) Demonstrate an ability to plan, organize, and create a product, service, or an event.
 - 4) Illustrate by individual performance the attained levels of knowledge and skills
 - 5) Include observation of events, groups, and individuals that focuses on the relevant traits of the skill in question

	e: Nanotechnology Technician action 5. Manufacture Nano-scale Product	Occupational Skills, Knowle	dae & Conditions
Key	Performance Criteria	Occupational Skills & Knowledge	Conditions
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?
5.1 Control environment	5.1.1 Charts or data show that environmental conditions are monitored and controlled to stay within specifications and tolerances for qualities such as temperature, vibration, airborne contaminants, and electromagnetic discharge, quality or condition of source power 5.1.2 Final product passes quality control tests	Understanding of statistical process control Understanding the importance of variance reporting Use of measuring instruments and tools Unit conversion Understanding of industry reference materials Understanding of ISO 9000 Knowledge of HAZMAT procedures	Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Lab equipment Oscilloscope Voltmeter Instrument interface software
5.2 Operate manufacturing equipment	 5.2.1 Appropriate process flow is identified and followed according to procedure 5.2.2 Components appropriate to the process are put to use 5.2.3 Processes such as material deposition or pattern transfers are executed within specification 5.2.4 Device or product is assembled using the specified components and packaged according to specification 5.2.5 Manufactured devices test out within performance specifications, and within expected failure percentages 5.2.6 Statistical process control is used appropriately, data is updated in a timely manner, charts are documented 	Understanding of statistical process control Understanding the importance of variance reporting Semiconductor manufacturing processes Mechanical precision to the nano scale High precision electrical measurements Crystallography and metallurgy Microscopy and spectroscopy Use of measuring instruments and tools Ability to use vacuum systems Ability to gauge repeatability and reproducibility Ability to read mechanical drawings Understanding of ISO 9000 Understanding of geometric dimensions and tolerances Knowledge of HAZMAT procedures	Personal protective equipment Semiconductor manufacturing equipment Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Lab equipment Instrument interface software Personal protective equipment

Occupational Title	Nanotechnology Technician	_	
Critical Work Func	tion 5. Manufacture Nano-scale Product	Occupational Skills, Knowle	dge & Conditions
Кеу	Performance Criteria	Occupational Skills & Knowledge	Conditions
Activity	How do we know when the key activity is performed well or performed successfully?	What should the technician know and what skills should the technician have in order to do the activity?	What tools must the technician use in order to do the activity?
5.3 Operate test equipment	 5.3.1 Tests are conducted according to established procedure 5.3.2 Excessive test failures are identified and reported according to procedure 5.3.3 Test equipment is calibrated according to schedule and records are current 5.3.4 Analysis of test results are effectively communicated to ensure manufacturing process parameters are maintained 	Knowledge of statistical process control Understanding the importance of variance reporting Volumetric measurement to the nano scale High precision electrical measurements Microscopy and spectroscopy Use of measuring instruments and tools Unit conversion Ability to use vacuum systems Ability to gauge repeatability and reproducibility Understanding of industry reference materials Understanding of ISO 9000 Understanding of HAZMAT procedures	Advanced optical microscopes Scanning probe microscopes Thin-film measurement equipment Spectrophotometer Laser interferometer X-ray Computer software (word processing, spreadsheet, database, presentation, email, etc.) Reference handbooks Lab equipment Oscilloscope Voltmeter Microbalance Instrument interface software
			Personal protective equipment

Academic and Employability Knowledge and Skill Matrix for Critical Work Function 5: Manufacture Nano-scale Product

On a scale of 1 (lowest) to 5 (highest), identify the level of complexity required in each of these skills for the worker to perform the critical work function. Keep in mind that this scale is not for rating an individual's proficiency. It is intended only for rating the level of complexity required to do the work.

Occupa	ational Ti	itle: Nanotechr	nology Tec	hnician												
CWF 5	CWF 5 Manufacture Nano-scale Product															
Listening	Speaking	Information and Communication	and	Solving	Decisions and	and	Using Social Skills	Adaptability	Working in Teams	Leading Others	Consensus	Self and Career Development	Writing	Reading	Mathematics	Science
3	3	3	3	3	3	3	3	3	4	3	3	3	2	3	3	3

Statement of Assessment for Critical Work Function 5: Manufacture Nano-scale Product

The statements of assessment can do any of several things:

- Define tools or strategies that industry could use to assess the level of competency a worker has attained in a particular critical work function.
- Define for trainers and educators how to assess the level of competency a student has attained relevant to the critical work function.
- Define the level of mastery of the critical work function that indicates that a worker or student has achieved an entry-, intermediate-, or advanced level of mastery of a critical work function.
- A. Tests could include:
 - 1) Multiple choice and essay questions that demonstrate an understanding of knowledge being assessed.
 - 2) Preparation and justification of a reasonable solution to a problem scenario.
- B. Hands-on exercises or simulations to demonstrate acquisition of knowledge and skills that could:
 - 1) Apply relevant knowledge or skills
 - 2) Focus on the application of knowledge and skills to a new situation
 - 3) Demonstrate an ability to plan, organize, and create a product, service, or an event.
 - 4) Illustrate by individual performance the attained levels of knowledge and skills
 - 5) Include observation of events, groups, and individuals that focuses on the relevant traits of the skill in question