

COMPETENCY-BASED OCCUPATIONAL FRAMEWORK FOR REGISTERED APPRENTICESHIP

Tool and Die Maker

ONET Code: 51-4111.00

RAPIDS Code: 0586

Created: March 2019

Updated:

This project has been funded, either wholly or in part, with Federal funds from the Department of Labor, Employment and Training Administration under Contract Number DOL-ETA-15-C-0087. The contents of this publication do not necessarily reflect the views or policies of the Department of Labor, nor does mention of trade names, commercial products, or organizations imply endorsement of the same by the US Government.

For more information, contact:

Diana Elliott, PhD, Senior Research Associate, Urban Institute: delliott@urban.org

Robert Lerman, PhD, Institute Fellow, Urban Institute: rlerman@urban.org





ABOUT THE URBAN INSTITUTE

The nonprofit Urban Institute is dedicated to elevating the debate on social and economic policy. For nearly five decades, Urban scholars have conducted research and offered evidence-based solutions that improve lives and strengthen communities across a rapidly urbanizing world. Their objective research helps expand opportunities for all, reduce hardship among the most vulnerable, and strengthen the effectiveness of the public sector.

Acknowledgments

We would like to thank several contributors for this framework. First, we would like to thank the National Institute for Metalworking Skills (NIMS), who helped to initially develop this framework and without whom we would not have been able to do this work. Specifically, we would like to thank Catherine Ross and Montez King, who have been critical in the development of this framework. We would also like to specifically thank Rick Nahmensen of True Manufacturing and Peter Ulintz of the Precision Metalforming Association, who have been invaluable in helping vet and further clarify this framework.

We would also like to thank several people who have contributed to the development and vetting of this framework. They include; Kevin Finan of the Atlantic Technical College; Rocco Garia and Linda Wood of Oberg Industries; Gene Holder of the Weaver Education Center; Douglas Metz of Rise Up Industries; and William Butrum of the Tennessee College of Applied Technology.

Contents

Acknowledgments.....	ii
Competency-Based Occupational Frameworks	1
Components of the Competency-Based Occupational Framework	2
Using the Competency-Based Occupational Framework to Develop a Registered Apprenticeship Program	3
Tool and Die Maker Occupational Overview.....	4
Occupational Purpose and Context	4
Potential Job Titles.....	4
Attitudes and Behaviors.....	4
Apprenticeship Prerequisites.....	4
Occupational Pathways.....	4
Certifications, Licensure, and Other Credential Requirements.....	5
Job Functions	6
Stackable Programs	6
Options and Specializations.....	6
Levels.....	7
Work Process Schedule.....	8
Related Technical Instruction Plan.....	12
Cross-Cutting Competencies.....	13
Detailed Job Functions.....	15
Job Function 2: Inspects materials, die components, features, and details.....	15
Job Function 3: Plans job and sets up workstation.....	17
Job Function 4: Sets up equipment and machine components and details	21
Job Function 5: Assembles tools and die.....	23
Job Function 6: Conducts tryouts and develops tools and die.....	27
Job Function 7: Troubleshoots tool and die problems	29
Job Function 8: Manages and coordinates projects.....	31
Statement of Independence	33

Competency-Based Occupational Frameworks

The Urban Institute, under contract with the US Department of Labor, has worked with employers, subject matter experts, labor unions, trade associations, credentialing organizations, and academics to develop Competency-Based Occupational Frameworks (CBOFs) for Registered Apprenticeship programs. These frameworks define the **purpose** of an occupation, the **job functions** that are carried out to fulfill that purpose, the **competencies** that enable the apprentice to execute those job functions well, and the **performance criteria** that define the specific knowledge, skills, and personal attributes associated with high performance in the workplace. This organizational hierarchy—job purpose, job functions, competencies, performance criteria—is designed to illustrate that performing work well requires more than just acquiring discrete knowledge elements or developing a series of manual skills. To perform a job well, the employee must be able to assimilate knowledge and skills learned in various settings, recall and apply that information to the present situation, and carry out work activities using sound professional judgment, demonstrating an appropriate attitude or disposition and achieving a level of speed and accuracy necessary to meet the employer’s business need.

The table below compares the terminology of Functional Analysis with that of traditional Occupational Task Analysis to illustrate the important similarities and differences. While both identify the key technical elements of an occupation, functional analysis includes the identification of behaviors, attributes, and characteristics of workers necessary to meet an employer’s expectations.

Framework Terminology	Traditional Task Analysis Terminology
Job Function: the work activities that are carried out to fulfill the job purpose	Job Duties: roles and responsibilities associated with an occupation
Competency: the actions an individual takes and the attitudes he/she displays to complete those activities	Task: a unit of work or set of activities needed to produce some result
Performance Criteria: the specific knowledge, skills, dispositions, attributes, speed, and accuracy associated with meeting the employer’s expectations	Subtask: the independent actions taken to perform a unit of work or activity

Although designed for use in competency-based apprenticeship, these Competency-Based Occupational Frameworks also support time-based apprenticeship by defining more clearly and precisely what an apprentice is expected to learn and do during the allocated time period.

CBOFs are comprehensive to encompass the full range of jobs that may be performed by individuals in the same occupation. As employers or sponsors develop their individual apprenticeship programs, they can extract from or add to the framework to meet their unique organizational needs.

Components of the Competency-Based Occupational Framework

Occupational Overview: This section of the framework provides a description of the occupation including its purpose, the setting in which the job is performed, and unique features of the occupation.

Work Process Schedule: This section includes the job functions and competencies that would likely be included in an apprenticeship sponsor's application for registration. These frameworks provide a point of reference that has already been vetted by industry leaders so sponsors can develop new programs knowing that they will meet or exceed the consensus expectations of peers. Sponsors maintain the ability to customize their programs to meet their unique needs, but omission of a significant number of job functions or competencies should raise questions about whether or not the program has correctly identified the occupation of interest.

Cross-Cutting Competencies: These competencies are common among all workers and focus on the underlying knowledge, attitudes, personal attributes, and interpersonal skills that are important regardless of the occupation. That said, while these competencies are important to all occupations, the relative importance of some versus others may change from one occupation to the next. These relative differences are illustrated in this part of the CBOF and can be used to design pre-apprenticeship programs or design effective screening tools when recruiting apprentices to the program.

Detailed Job Function Analysis: This portion of the framework includes considerable detail and is designed to support curriculum designers and trainers in developing and administering the program. The detail in this section may be confusing to those seeking a more succinct, higher-level view of the program. For this reason, we recommend that the Work Process Schedule be the focus of program planning activities, leaving the detailed job function analysis sections to instructional designers as they engage in their development work.

- a. **Related Technical Instruction:** Under each job function appears a list of foundational knowledge, skills, tools, and technologies that would likely be taught in the classroom to enable the apprentice's on-the-job training safety and success.
- b. **Performance Criteria:** Under each competency, we provide recommended performance criteria that could be used to differentiate between minimally, moderately, and highly competent apprentices. These performance criteria are generally skills based rather than knowledge based but may also include dispositional and behavioral competencies.

Using the Competency-Based Occupational Framework to Develop a Registered Apprenticeship Program

When developing a registered apprenticeship program, the Work Process Schedule included in this CBOF provides an overview of the job functions and competencies an expert peer group deemed to be important to this occupation. The Work Process Schedule in this document can be used directly, or modified and used to describe your program content and design as part of your registration application.

When designing the curriculum to support the apprenticeship program—including on-the-job training and related technical instruction—the information in the Detailed Job Functions section could be helpful. These more detailed documents include recommendations for the key knowledge and skills that might be included in the classroom instruction designed to support a given job function, and the performance criteria provided under each competency could be helpful to trainers and mentors in evaluating apprentice performance and insuring inter-rater reliability when multiple mentors are involved.

Tool and Die Maker Occupational Overview

Occupational Purpose and Context

Entry-level tool and die makers analyze specifications, lay out metal stock, set up and operate machine tools, and fit and assemble parts to make and repair dies, cutting tools, jigs, fixtures, gauges, and machinists' hand tools. Apprentices will learn to safely set up, operate, monitor, and control production equipment. They will also help improve manufacturing processes and schedules to meet customer requirements. Industrial Manufacturing Technicians provide a baseline foundation for other occupations, including in the job areas of mechatronics and machinists. Industrial Manufacturing Technicians engage in the production of a diverse set of products including, but not limited to, consumer goods, automobiles, medical devices, food products, and commercial parts and supplies.

Potential Job Titles

Aircraft Tool Maker, Carbide Tool Die Maker, Die Maker, Jig and Fixture Builder, Jig and Fixture Repairer, Tool and Die Machinist, Tool and Die Maker, Tool Repairer, Toolmaker, Trim Die Maker

Attitudes and Behaviors

Tool and die makers should have well-developed critical thinking skills to solve problems quickly, identify errors or inconsistencies in product quality, stay focused and observe the work process despite distractions, combine pieces of information to form general rules or conclusions that they should communicate clearly, and arrange objects or actions in an order or pattern related to a specific rule or set of rules.

Apprenticeship Prerequisites

Some programs may require apprentices to pass drug testing before beginning the apprenticeships. Apprentices should also have basic layout, job planning, and general machining skills.

Occupational Pathways

Tool and die workers may move from production and assembly jobs to quality assurance positions, production control jobs, inventory management positions, and supervisory roles.

Certifications, Licensure, and Other Credential Requirements

Credential	Offered by	Before, During, or After Apprenticeship
Measurement, Materials, and Safety	NIMS	During
Job Planning, Benchwork, and Layout	NIMS	During
Drill Press Skills	NIMS	During
Surface Grinding Skills	NIMS	During
Cylindrical Grinding Skills	NIMS	During
Diemaking Level III	NIMS	During
Moldmaking Level II	NIMS	During
Manual Milling Skills I and II	NIMS	During
CNC Milling: Program Setup and Operations	NIMS	During
CNC Milling Skills II	NIMS	During
Turning Operations: Turning Between Centers I	NIMS	During
Turning Operations: Turning Chucking Skills	NIMS	During
CNC Turning: Programming Setup and Operations	NIMS	During
Turning II: Chucking	NIMS	During
Turning II: Between Centers	NIMS	During
CNC Turning Skills II	NIMS	During
EDM: Plunge	NIMS	During
EDM: Two-Axis Wire	NIMS	During

Job Functions

Job Functions	Core or Optional
1. Inspects materials, die components, features, and details	Core
2. Plans job and sets up workstation	Core
3. Sets up equipment and machine components and details	Core
4. Assembles tools and die	Core
5. Conducts tryouts and develops tools and die	Core
6. Troubleshoots tool and die problems	Core
7. Manages and coordinates projects	Core

Stackable Programs

This occupational framework is designed to link to the following additional framework(s) as part of a career laddering pathway.

Stackable Programs	Base or Higher Level	Stacks on Top of
n/a		

Options and Specializations

The following options and specializations have been identified for this occupation. The Work Process Schedule and individual job function outlines indicate which job functions and competencies were deemed by industry advisors to be optional. Work Process Schedules for Specializations are included at the end of this document.

Options and Specializations	Option	Specialization
Aircraft Toolmaker		
Carbide Tool Die Maker		
Die Maker		
Jig and Fixture Builder		
Jig and Fixture Repairer		
Tool and Die Machinist		

Tool and Die Maker		
Tool Repairer		
Toolmaker		
Trim Die Maker		

Levels

Industry advisors have indicated that individuals in this occupation may function at different levels, based on the nature of their work, the amount of time spent in an apprenticeship, the level of skills or knowledge mastery, and the degree of independence in performing the job or supervisory/management responsibilities.

Level	Distinguishing Features	Added Competencies	Added Time Requirements
1	Operator		
2	Troubleshooter		
3	Team Leader		
4	Quality Assurance Specialist		

Work Process Schedule

WORK PROCESS SCHEDULE		ONET Code: 51-4111.00
Tool and Die Maker		RAPIDS Code: 0586
Job Title: Tool and Die Maker		
Level:	Specialization:	
Stackable Program: <input type="checkbox"/> Yes <input type="checkbox"/> No		
Base Occupation Name:		
Company Contact:		
Address:	Phone:	Email:
Apprenticeship Type: <input checked="" type="checkbox"/> Competency Based <input type="checkbox"/> Time Based <input type="checkbox"/> Hybrid		Prerequisites:

Job Function 1: Inspects materials, die components, features, and details			
Competencies	Core or Optional	RTI	OJT
A. Measures size of raw materials	Core		
B. Checks surface finish for detects and flaws	Core		
C. Identifies material by type	Core		
D. Verifies calibration of measurement devices	Core		
E. Converts measurements	Core		
F. Locates center lines, checks fit and form using gaging, and measures threads	Core		

Job Function 2: Plans job and sets up workstation			
Competencies	Core or Optional	RTI	OJT
A. Reviews and verifies prints and drawings	Core		
B. Obtains and stages raw materials and verifies bill of materials	Core		
C. Prioritizes and schedules workflow/progression	Core		
D. Determines availability of materials and equipment	Core		
E. Obtains and stages die premanufactured components	Core		
F. Determines grinding and heat-treating allowances	Core		
G. Sketches/highlights critical processing information and specs	Core		
H. Determines machining requirements and processes	Core		
I. Verifies/assesses shut height specifications, tonnage requirements, and feedline	Core		
J. Checks safety devices for function	Core		
K. Identifies and determines availability of perishable tooling	Core		
L. Verifies availability of tryout material	Core		
M. Determines resources to adhere to die-building and tryout times	Core		
N. Determines lubrication requirements and plumbing standards	Core		
O. Assesses part and scrap-ejection methods	Core		

Job Function 3: Sets up equipment and machine components and details			
Competencies	Core or Optional	RTI	OJT
A. Moves and stages material and parts for machining (CNC/non-CNC) and polishes parts	Core		
B. Inspects machined work pieces for quality and compliance and removes burr from machined parts	Core		

Job Function 4: Assembles tools and die			
Competencies	Core or Optional	RTI	OJT
A. Ensures punch is at die clearance	Core		
B. Mounts and checks details for fit and function, punching tools, and forming tools and components	Core		
C. Installs and fits cutting and drawing tools and components	Core		
D. Installs and sets pressure devices or systems and stripping and holding devices	Core		
E. Establishes and sets die timing and mounts/adjusts CAMs or sliding components	Core		
F. Verifies/adjusts slug clearance and grinds/deburrs and mount parallels	Core		
G. Mounts/aligns in-die assembly and hardware and tapping heads	Core		
H. Installs and sets quick die-change components, scrap removal, and part-ejection devices	Core		
I. Installs quality control (QC) sensors and electronics and die-protection sensors and devices	Core		
J. Aligns upper and lower die assembly and checks/adjusts material feed and level on the bench	Core		
K. Installs/makes guide components and checks for sharp edges on noncutting tools	Core		
L. Verifies presence of or installs balances and levelers and sets blocks	Core		

Job Function 5: Conducts tryouts and develops tools and die			
Competencies	Core or Optional	RTI	OJT
A. Sets up and conducts press for dry run and/or tryouts	Core		
B. Develops blank/trim profiles	Core		
C. Checks/adjusts shut height and sets blocks	Core		
D. Analyzes, solves, and corrects formability problems and runs at proper rate	Core		
E. Inspects and submits tryout parts for quality and conformance	Core		

Job Function 6: Troubleshoots tool and die problems			
Competencies	Core or Optional	RTI	OJT
A. Understands how to read strip	Core		
B. Isolates the cause of why strip is not feeding straight into or through die	Core		
C. Determines why tool steel is chipping or showing premature wear	Core		
D. Determines why die components are breaking	Core		
E. Finds out why scrap or materials are accumulating in the die	Core		
F. Isolates the cause of why a sensor has shut down the press	Core		

Job Function 7: Manages and coordinates projects			
Competencies	Core or Optional	RTI	OJT
A. Reliably follows the instructions of others	Core		
B. Willingly asks questions about things not fully understood	Core		
C. Works with due regard for the safety of others	Core		
D. Establishes a system of maintaining appropriate notes and reminders and completes any required logs, calibration records, etc.	Core		
E. Ensures proper communications between previous and next shifts, with both operations and supervision	Core		
F. Identifies problems and changes that could lead to problems by exchanging information with operators, supervisors, and others	Core		
G. Establishes trust and rapport with operators, supervisors, and others	Core		

Related Technical Instruction Plan

COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	

COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	

COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	

COURSE NAME	Course Number
	Hours
LEARNING OBJECTIVES	

Cross-Cutting Competencies

COMPETENCY**		0	1	2	3	4	5	6	7	8
Personal Effectiveness	Interpersonal Skills	0	1	2	3	4	5	6	7	8
	Integrity	0	1	2	3	4	5	6	7	8
	Professionalism	0	1	2	3	4	5	6	7	8
	Initiative	0	1	2	3	4	5	6	7	8
	Dependability and Reliability	0	1	2	3	4	5	6	7	8
	Adaptability and Flexibility	0	1	2	3	4	5	6	7	8
	Lifelong Learning	0	1	2	3	4	5	6	7	8
Academic	Reading	0	1	2	3	4	5	6	7	8
	Writing	0	1	2	3	4	5	6	7	8
	Mathematics	0	1	2	3	4	5	6	7	8
	Science and Technology	0	1	2	3	4	5	6	7	8
	Communication	0	1	2	3	4	5	6	7	8
	Critical and Analytical Thinking	0	1	2	3	4	5	6	7	8
	Basic Computer Skills	0	1	2	3	4	5	6	7	8
Workplace	Teamwork	0	1	2	3	4	5	6	7	8
	Customer Focus	0	1	2	3	4	5	6	7	8
	Planning and Organization	0	1	2	3	4	5	6	7	8
	Creative Thinking	0	1	2	3	4	5	6	7	8
	Problem Solving and Decision Making	0	1	2	3	4	5	6	7	8
	Working with Tools and Technology	0	1	2	3	4	5	6	7	8
	Checking, Examining, and Recording	0	1	2	3	4	5	6	7	8
	Business Fundamentals	0	1	2	3	4	5	6	7	8
	Sustainable	0	1	2	3	4	5	6	7	8
	Health and Safety	0	1	2	3	4	5	6	7	8

** The names of the cross-cutting competencies come from the US Department of Labor’s Competency Model Clearinghouse, and definitions for each can be viewed at <https://www.careeronestop.org/CompetencyModel/competency-models/building-blocks-model.aspx>.

Cross-cutting competencies identify transferable skills—sometimes called “soft skills” or “employability skills”—that are important for workplace success, regardless of a person’s occupation. Still, the relative

importance of specific cross-cutting competencies differs from occupation to occupation. The cross-cutting competencies table, above, provides information about which of these competencies is most important to be successful in a particular occupation. This information can be useful to employers or intermediaries in screening and selecting candidates for apprenticeship programs, or to pre-apprenticeship providers who seek to prepare individuals for successful entry into an apprenticeship program.

The scoring system utilized to evaluate competency levels required in each cross-cutting skill aligns with the recommendations of the Lumina Foundation's Connecting Credentials Framework. The framework can be found at <http://connectingcredentials.org/wp-content/uploads/2015/05/ConnectingCredentials-4-29-30.pdf>.

Detailed Job Functions

Job Function 1: Inspects materials, die components, features, and details

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Proper measurements • Conversions • Safety equipment functionality 	<ul style="list-style-type: none"> • Selecting proper tools and procedures • Using proper procedures when working • Basic mathematics • Maintaining situational awareness • Clear thinking • Identifying problems and correcting them 	<ul style="list-style-type: none"> • Raw materials • Measurement devices

Competency A: Measures size of raw materials	Core or Optional
PERFORMANCE CRITERIA	
1. Measures diameters (ID/OD) and GD and T	Core
2. Determines hardness of surfaces	Core
3. Measures point-to-point distances, radius/radii, angles, and material thinning of production part	Core
4. Calculates unknown dimensions	Core
5. Measures burr height of production part	Core

Competency B: Checks surface finish for defects and flaws	Core or Optional
PERFORMANCE CRITERIA	
1. Ensures mounting surfaces are clean, dry, smooth, flat, and defect free	Core

Competency C: Identifies material by type	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies and explains the color-coding designations of materials, labeling system and "Right to Know" information	Core

Competency D: Verifies calibration of measurement devices	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies the proper calculations to solve the unknown dimension	Core
2. Converts to the same unit of measure as stated on the print manual (English/metric)	Core
3. Double-checks all calculations (i.e., angles, arcs, point-to-point distances, diameters, radius/radii, etc.)	Core
4. Locates the dimension on the part, part feature, or prototype	Core
5. Accurately measures the dimension to confirm the calculation is correct	Core
6. Solves unknown dimensions	Core

Competency E: Converts measurements	Core or Optional
PERFORMANCE CRITERIA	
1. Converts measurements from metric to standard	Core

Competency F: Locates center lines, checks fit and form using gaging, and measures threads	Core or Optional
PERFORMANCE CRITERIA	
1. Locates the center lines of materials	Core
2. Uses the gag to check fit and form	Core
3. Measures lengths of threads	Core

Job Function 2: Plans job and sets up workstation

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Proper measurements • Conversions • Safety equipment functionality 	<ul style="list-style-type: none"> • Selecting proper tools and procedures • Locating proper materials • Using proper procedures when working • Basic mathematics • Maintaining situational awareness • Clear thinking • Identifying problems and correcting them 	<ul style="list-style-type: none"> • Raw materials • Tools and dies • Prints and records • Measurement devices

Competency A: Reviews and verifies prints and drawings		Core or Optional
PERFORMANCE CRITERIA		
1. Obtains necessary archives, records, studies, documents, prints, data, and manuals		Core
2. Verifies the prints and drawings to ensure they meet standards		Core

Competency B: Obtains and stages raw materials and verifies bill of materials		Core or Optional
PERFORMANCE CRITERIA		
1. Identifies the necessary raw materials needed to design and develop the tool, reviews the MSDS or other safety/environmental requirements in order to evaluate any hazardous materials and/or conditions associated with the diemaking project and establish initial safe work practices		Core

Competency C: Prioritizes and schedules workflow/progression		Core or Optional
PERFORMANCE CRITERIA		
1. Reviews a die-building plan or design and part prints, locates details and forming/cutting operations, and verifies die-to-press relationships; then develops a die- machining process plan or workflow diagram before die assembly operations		Core

Competency D: Determines availability of materials and equipment	Core or Optional
PERFORMANCE CRITERIA	
1. Checks blueprints and manuals to determine what materials are needed	Core
2. Checks to see if materials are available at worksite	Core
3. Documents the process of obtaining materials	Core
4. Identifies appropriate individuals to obtain additional materials if necessary	Core

Competency E: Obtains and stages premanufactured components	Core or Optional
PERFORMANCE CRITERIA	
1. Gathers appropriate tools according to needs of production run/finishing	Core
2. Uses well-performing tools and follows procedures for replacing or servicing malfunctioning or broken tool	Core
3. Prepares details for sub-assembly; then cleans, mounts, and installs details before fitting and aligning upper and lower forms for dry run tryout	Core

Competency F: Determines grinding and heat-treating allowances	Core or Optional
PERFORMANCE CRITERIA	
1. Observes or monitors heat-treating operations (in-plant or off-site), noting types of furnaces used and the effects of temperature, timed heat, and heating rate on metals	Core
2. Conducts hardness testing and then interprets and records findings	Core
3. Prepares details for quality inspections after heat-treating, validates die details to print or die design specifications, and prepares reports on the compliance of the details	Core

Competency G: Sketches/highlights critical processing information and specs	Core or Optional
PERFORMANCE CRITERIA	
1. Draws up the specifications of the materials and the impact of processes on the specifications	Core

Competency H: Determines machining requirements and processes	Core or Optional
PERFORMANCE CRITERIA	
1. Reads blueprints, sketches, specifications, or CAD and CAM files for making tools and dies	Core
2. Computes and verifies dimensions, sizes, shapes, and tolerances of workpieces	Core

Competency I: Verifies/assesses shut height specifications, tonnage requirements, and feedline	Core or Optional
PERFORMANCE CRITERIA	
1. Calculates shut height	Core
2. Initiates shut height preset just above (or greater than) the required shut height	Core
3. Sets tonnage monitor to not exceed die requirement tonnage	Core
4. Verifies maximum allowable tonnage was not exceeded	Core
5. Sets tonnage monitor to allow specified tonnage range	Core

Competency J: Checks safety devices for function	Core or Optional
PERFORMANCE CRITERIA	
1. Locates and identifies a variety of safety devices (engineering controls—i.e., duel palm controls, safe distancing barriers, light curtains, motion sensors, etc.) for machine shop and pressroom equipment and states the required PPE/PPC necessary to operate or set up the equipment (safety blocks, safety glasses, safety boots, hard hat, pullbacks, special gloves, ear plugs, hand/arm protection, etc.)	Core

Competency K: Identifies and determines availability of perishable tooling	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies and determines availability of tools that can be disposed after production run through manuals and searches	Core

Competency L: Verifies availability of tryout material	Core or Optional
PERFORMANCE CRITERIA	
1. Checks blueprints and manuals to determine what materials are needed	Core
2. Ensures a tryout press is available	Core
3. Identifies appropriate individuals to obtain additional materials if necessary	Core

Competency M: Determines resources to adhere to die-building and tryout times	Core or Optional
PERFORMANCE CRITERIA	
1. Checks prints and manuals to determine the necessary resources	Core
2. Gauges the availability of these resources	Core
3. Identifies appropriate individuals to obtain additional materials if necessary	Core

Competency N: Determines lubrication requirements and plumbing standards	Core or Optional
PERFORMANCE CRITERIA	
4. Locates, checks, and fills all applicable lubrication reservoirs, checking for proper oil pressure, and ensures that all lubrication points are functioning properly	Core

Competency O: Assesses part and scrap-ejection methods	Core or Optional
PERFORMANCE CRITERIA	
1. Assures that all stock-feeding problems have been resolved, all slugs fall freely from the die and down the scrap chutes or between parallels, and that the part falls freely from die in the cutoff station when applicable	Core

Job Function 3: Sets up equipment and machine components and details

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Milling and grinding • Turning 	<ul style="list-style-type: none"> • Selecting proper tools and procedures • Locating proper materials • Using proper procedures when working • Basic mathematics • Maintaining situational awareness • Clear thinking • Identifying problems and correcting them 	<ul style="list-style-type: none"> • Raw materials • Grinders • Tools and dies • Measurement devices

Competency A: Moves and stages material and parts for machining (CNC/non-CNC) and polishes parts	Core or Optional
PERFORMANCE CRITERIA	
1. Drills/taps holes and countersinks/counters bore holes	Core
2. Bores/reams and grinds holes	Core
3. Schedules heat treatments	Core
4. Grinds edges, flats, forms, and outside diameter	Core
5. Squares block, threads diameters, and mills slots, pockets, and keyways (2-D milling)	Core
6. Turns diameters (chucked CNC or non-CNC) between centers	Core
7. Roughly cuts/saws tool steel and details and laps/hones holes	Core
8. Grinds graphite electrodes and makes shims	Core

Competency B: Inspects machined work pieces for quality and compliance and removes burr from machined parts		Core or Optional
PERFORMANCE CRITERIA		
1. Properly shuts down grinder		Core
2. Removes workpiece once the wheel completely stops		Core
3. Ensures workpiece dimensions are within tolerance		Core
4. Checks that workpiece surface finish is within tolerance		Core
5. Ensures workpiece cosmetics are acceptable		Core

Job Function 4: Assembles tools and die

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> Grinding and cutting Installation and settings Mounts and alignments Safety equipment functionality 	<ul style="list-style-type: none"> Selecting proper tools and procedures Locating proper materials Using proper procedures when working Basic mathematics Maintaining situational awareness Clear thinking Identifying problems and correcting them 	<ul style="list-style-type: none"> Raw materials Tools and dies Blocks Drills and other tools CAD/CAM software Measurement devices QC sensors and devices

Competency A: Ensures punch is set to die clearance	Core or Optional
PERFORMANCE CRITERIA	
1. Locates and matches lower details to print and die specifications	Core
2. Sets clearance between upper and lower press	Core
3. Successfully transfers screw holes to lower die shoe	Core
4. Transfers screws sticking up 1/16th;" (uses weight of die shoes to make points)	Core
5. Punches or drills and counterbores transfer holes accurately	Core
6. Drills 1/32" over size of socket head cap screw	Core
7. Sets die clearance between secured form steel and bolts, ensuring no damage to threads and heads	Core
8. Assembles and fits details in proper sequence and locations	Core

Competency B: Mounts and checks details for fit and function, punching tools, and forming tools and components	Core or Optional
PERFORMANCE CRITERIA	
1. Locates and matches upper drills to print and die specifications	Core
2. Transfers screw holes to upper die	Core
3. Transfers screws sticking up 1/16th"	Core
4. Punches/drills and counterbores transfer holes accurately to die design	Core
5. Drills 1/32" over size of socket head cap screw	Core

6. Assembles and fits details in proper sequence and location	Core
7. Locates and (temporarily) bolts upper detail/die	Core
8. Demonstrates competency using tools, equipment, fastening/joining devices, and precision measuring instruments	Core

Competency C: Installs and fits cutting and drawing tools and components	Core or Optional
PERFORMANCE CRITERIA	
1. Locates, fits, and installs cutting tools and components	Core
2. Locates, installs, and aligns drawing tools and components	Core

Competency D: Installs and sets pressure devices or systems and stripping and holding devices	Core or Optional
PERFORMANCE CRITERIA	
1. Sets and supports line run into connectors from source to press	Core
2. Checks that there are no kinks, leaks, or extreme bends in and throughout length of line	Core
3. Ensures line not contaminated	Core
4. Flows lube or coolant at designed pressure through line without incident or malfunction	Core
5. Sets pressure/flow rate at the right amount of coolant or lubrication and ensures it's being delivered to the proper location, device, or output	Core

Competency E: Establishes and sets die timing and mounts/adjusts CAMs or sliding components	Core or Optional
PERFORMANCE CRITERIA	
1. Calculates and programs coordinates without the use of CAD/CAM software, conversational control, or a programmable calculator and makes parts on a CNC turning machine (or lathe)	Core
2. Renders the part for the assigned job using CAD software, imports part geometry in a CAM software system, and makes parts/details on a CNC machine	Core
3. Makes parts/details on a CNC machine, but allows for the part geometry to be imported by the apprentice from an outside source or created/edited by the apprentice on a CAD/CNC system	Core

Competency F: Verifies/adjusts slug clearance and grinds/deburrs and mounts parallels		Core or Optional
PERFORMANCE CRITERIA		
1. Activates press (rolled or jogged) and cuts, punches, and shears material. Ensures slug hole larger than die opening and that slug hole did not overlap with die opening		Core
2. Checks punch function for quality, position, and alignment		Core
3. Cleans even shear to break with no/minimum burr		Core
4. Meets breakoff, cut band, radius, and taper specification standards, tolerances, and customer requirements		Core
5. Meets dimensions, geometry, and feature location part standards and customer requirements		Core
6. Conforms characteristics to quality standards (no cracks, wrinkles, tool marks, burr, etc.)		Core
7. Ensures clearance equal around cutting edges		Core

Competency G: Mounts/aligns in-die assembly and hardware and tapping heads		Core or Optional
PERFORMANCE CRITERIA		
1. Replaces or relocates a faulty in-die proximity sensor and adjusts and resets another faulty sensor to be determined by the company (i.e., photo electric or pneumatic)		Core

Competency H: Installs and sets quick die-change components, scrap removal, and part-ejection devices		Core or Optional
PERFORMANCE CRITERIA		
1. Ensures that all stock-feeding problems have been resolved, all slugs fall freely from the die and down the scrap chutes or between parallels, and that the part falls freely from die in the cutoff station when applicable		Core

Competency I: Installs Quality Control (QC) sensors and electronics and die-protection sensors and devices		Core or Optional
PERFORMANCE CRITERIA		
1. Obtains, stages, and cleans QC measurement devices and ensures they are showing no damage or malfunction and that calibration stickers/tags are current		Core
2. Installs sensors and electronics		Core
3. Removes/deactivates bug or removes/replaces/repairs the defective material, component, or device		Core
4. Tests theory and corrective action(s) and restores normal operations		Core
5. Ensures machine/die producing good parts at stated rate of production		Core

Competency J: Aligns upper and lower die assembly and checks/adjusts material feed and level on the bench	Core or Optional
PERFORMANCE CRITERIA	
1. Aligns and keys upper/lower form details for backup	Core
2. Ensures inserts are bolted to keyed block	Core
3. Establishes proper clearance	Core
4. Prepares die set for press-shimming activities (in or out) to get the correct form	Core
5. Conducts die dry run or prepares first tryout	Core

Competency K: Installs/makes guide components and checks for sharp edges on noncutting tools	Core or Optional
PERFORMANCE CRITERIA	
1. Identifies and marks first strip (edge) stop	Core
2. Checks materials for sharp edges on noncutting tools	Core

Competency L: Verifies presence of or installs balances and levelers and sets blocks	Core or Optional
PERFORMANCE CRITERIA	
1. Establishes or installs balances and levelers	Core
2. Uses the machine to set block square (parallel and perpendicular) to tolerances specified by the supervisor or print	Core

Job Function 5: Conducts tryouts and develops tools and die

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> Grinding and cutting Installation and settings Safety equipment functionality 	<ul style="list-style-type: none"> Selecting proper tools and procedures Locating proper materials Using proper procedures when working Basic mathematics Maintaining situational awareness Clear thinking Identifying problems and correcting them 	<ul style="list-style-type: none"> Raw materials Tools and dies Blocks

Competency A: Sets up and conducts press for dry run and/or tryouts	Core or Optional
PERFORMANCE CRITERIA	
1. Adjusts/replaces/relocates sensors	Core
2. Checks for interference, adjusts clearance, and adjusts/resets timing	Core
3. Reworks/replaces forms and draws and then adjusts draw beads	Core
4. Adjusts or reworks tooling, pressures, and ejection devices or systems	Core
5. Feeds/runs strip to start point (first stop) and jog strip through stations	Core
6. Sets/adjusts pilot release	Core
7. Applies die lubrication, forming lubes and verifying feed progression and pilot release	Core

Competency B: Develops blank/trim profiles	Core or Optional
PERFORMANCE CRITERIA	
1. Positions/sets part for profile/feature inspection/comparison verification (dimensional and geometric)	Core
2. Initiates and initializes program	Core
3. Checks part profile and hole positions(s) and size (CMM/AIO/VS only)	Core

4. Puts comparator (shadow or reflection) in correct position and accurately checks part profile/control limits and features (location, position, and size)	Core
5. Shuts down equipment and records results	Core

Competency C: Checks/adjusts shut height and sets blocks	Core or Optional
PERFORMANCE CRITERIA	
1. Demonstrates safe work practices when lifting and mounting the die	Core
2. Aligns and centers die, ensuring ram is adjusted to make contact with punch holder	Core
3. Secures clamps and ensures proper fit is attained	Core
4. Adjusts ram to .050 (thickness on lead)	Core
5. Ensures press has enough travel or shut height to handle thickness of material	Core

Competency D: Analyzes, solves, and corrects formability problems and runs at proper rate	Core or Optional
PERFORMANCE CRITERIA	
1. Understands the cause-and-effect relationship between material specifications and formability to trim and scrap management	Core

Competency E: Inspects and submits tryout parts for quality and conformance	Core or Optional
PERFORMANCE CRITERIA	
1. Tests molds or die on tryout presses	Core
2. Performs capability assessment	Core
3. Reworks tool if necessary	Core

Job Function 6: Troubleshoots tool and die problems

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> • Troubleshooting and root-cause isolation • Safety equipment functionality 	<ul style="list-style-type: none"> • Selecting proper tools and procedures • Locating proper materials • Using proper procedures when working • Basic mathematics • Maintaining situational awareness • Clear thinking • Identifying problems and correcting them 	<ul style="list-style-type: none"> • Raw materials • Tools and dies • Molds • Strip • Tool steel • Drills and other tools • CAD/CAM software

Competency A: Understands how to read strip	Core or Optional
PERFORMANCE CRITERIA	
1. Tests molds or die on tryout presses	Core
2. Performs capability assessment	Core
3. Reworks tool if necessary	Core

Competency B: Isolates the cause of why strip is not feeding straight into or through die	Core or Optional
PERFORMANCE CRITERIA	
1. Responds to a slug-pulling situation	Core
2. Determines why galling has occurred	Core
3. Finds out why material is wrinkling or splitting	Core
4. Finds out why part dimensions are varying or out of control	Core

Competency C: Determines why tool steel is chipping or showing premature wear		Core or Optional
PERFORMANCE CRITERIA		
1. Diagnoses tooling in various conditions and takes the correct steps to put the tooling back in service		Core
2. Performs cutter-sharpening operations		Core
3. Understands insert identification nomenclature and index or change inserts		Core
4. Locates, checks, and fills all applicable lubrication reservoirs, checking for proper oil pressure and that all lubrication points are functioning properly		Core
5. Checks the general condition of the equipment and makes routine adjustments as stated in the maintenance schedule		Core

Competency D: Determines why die components are breaking		Core or Optional
PERFORMANCE CRITERIA		
1. Runs final tryout and finds the reason why the strip or coil will not feed correctly though the die area		Core
2. Conducts final runoff and performs casual troubleshooting analysis to find out why part size or dimension is not matching print requirements or part design specifications		Core
3. Finds the “root cause” of why a die component is malfunctioning or breaking in the production press line		Core

Competency E: Finds out why scrap or materials are accumulating in the die		Core or Optional
PERFORMANCE CRITERIA		
1. Verifies that there are no pieces of loose scrap, slugs, or obstructions in the die		Core
2. Ensures the coil material is being adequately straightened, leveled, and flattened before entering the die		Core
3. Ensures scraps and slugs falling from the die are being carried away properly and that all slug shuts and shakers are functioning correctly		Core

Competency F: Isolates the cause of why a sensor has shut down the press		Core or Optional
PERFORMANCE CRITERIA		
1. Defines the trouble path (electrical, mechanical, hydraulic, electronic, material, sensor, etc.) and locates the problem area		Core
2. Finds the problem (bug, defect, or malfunction) within the allotted time limit		Core

Job Function 7: Manages and coordinates projects

Related Technical Instruction		
KNOWLEDGE	SKILLS	TOOLS & TECHNOLOGIES
<ul style="list-style-type: none"> Company policies and hierarchy 	<ul style="list-style-type: none"> Using proper procedures when working Maintaining situational awareness Logical thinking Clear oral communication Identifying problems and correcting them Teamwork 	<ul style="list-style-type: none"> None

Competency A: Reliably follows the instructions of others	Core or Optional
PERFORMANCE CRITERIA	
1. Follows the instructions of supervisors and offers constructive feedback to ensure proper completion of tasks	Core

Competency B: Willingly asks questions about things not fully understood	Core or Optional
PERFORMANCE CRITERIA	
1. Asks about techniques, components, installation, technical aspects, and other key areas of job that are not fully clear	Core

Competency C: Works with due regard for the safety of others	Core or Optional
PERFORMANCE CRITERIA	
1. Demonstrates safe workplace practices in material handling, machine operations, and handling of tools	Core
2. Explains actions that directly or indirectly affect safe practices during assigned responsibilities	Core

Competency D: Establishes a system of maintaining appropriate notes and reminders and completes any required logs, calibration records, etc.	Core or Optional
PERFORMANCE CRITERIA	
1. Writes and records the information critical for the proper job functioning	Core
2. Types information into easily accessible computer filing systems	Core

Competency E: Ensures proper communications between previous and next shifts, with both operations and supervision	Core or Optional
PERFORMANCE CRITERIA	
1. Demonstrates appropriate interpersonal skills with a supervisor or team leader and other team members to ensure work is smoothly continued from one shift to the next	Core

Competency F: Identifies problems and changes that could lead to problems by exchanging information with operators, supervisors, and others	Core or Optional
PERFORMANCE CRITERIA	
1. Analyzes the problem(s) and proposes remedies when authorized to carry them out	Core

Competency G: Establishes trust and rapport with operators, supervisors, and others	Core or Optional
PERFORMANCE CRITERIA	
1. Interfaces with members of the team to discuss work and any issues that may arise	Core

STATEMENT OF INDEPENDENCE

The Urban Institute strives to meet the highest standards of integrity and quality in its research and analyses and in the evidence-based policy recommendations offered by its researchers and experts. We believe that operating consistent with the values of independence, rigor, and transparency is essential to maintaining those standards. As an organization, the Urban Institute does not take positions on issues, but it does empower and support its experts in sharing their own evidence-based views and policy recommendations that have been shaped by scholarship. Funders do not determine our research findings or the insights and recommendations of our experts. Urban scholars and experts are expected to be objective and follow the evidence wherever it may lead.



500 L'Enfant Plaza
Washington, DC 20024

www.urban.org