

MACHINISTS

A DEEP DIVE FOR SKILLS-BASED HIRING

REV: 04/04/16

Occupation Overview: Machinist

Foundational Competencies

- **Operation Monitoring:** Watching gauges, dials, or other indicators to make sure a machine is working properly.
- **Critical Thinking:** Using logic and reasoning to identify the strengths and weaknesses of alternative solutions, conclusions, or approaches to problems.
- **Operation and Control:** Controlling operations of equipment or systems.
- **Active Listening:** Giving full attention to what other people are saying, taking time to understand the points being made, asking questions as appropriate, and not interrupting at inappropriate times.
- **Judgment and Decision Making:** Considering the relative costs and benefits of potential actions to choose the most appropriate one.
- **Coordination:** Adjusting actions in relation to others' actions.
- **Active Learning:** Understanding the implications of new information for both current and future problem solving and decision making.
- **Complex Problem Solving:** Identifying complex problems and reviewing related information to develop and evaluate options and implement solutions.
- **Equipment Selection:** Determining the kind of tools and equipment needed to do a job.
- **Quality Control Analysis:** Conducting tests and inspections of products, services, or processes to evaluate quality or performance.

Occupation-Specific Competencies

- **Intermediate Machine Tools:** Certification and/or proficiency with machine tools such as power grinders, milling cutters, drill presses, lathes, calipers, tool dies, and their dial indicators.
- **Basic Computer-Aided Manufacturing:** Proficiency with computer-assisted design programs (e.g. CAD, CAM) and processes/machines (e.g. 5-axis machining, CNC machines, mills, and lathes).
- **Basic Industrial Design:** Ability to create and/or use schematic diagrams, blueprints, and sketching when designing industrial products.
- **Intermediate Mathematics:** Competency in manipulating numbers, quantities, shapes, and spaces.
- **Intermediate Machinery:** Ability to safely and appropriately operate, demonstrate, clean, and lubricate machines.
- **Intermediate Hand Tools:** Ability to safely and appropriately use sledgehammers, chisels, wire strippers, hammers, screwdrivers, hacksaws, and other hand tools.
- **Basic Manufacturing Processes:** Understanding Six Sigma processes at a green or black belt levels, Kaizen, and lean manufacturing.
- **Basic Welding:** Proficiency with several types of welding (e.g. gas-metal arc welding, stick welding, structural welding, pipe welding) and welding equipment (portable grinders, cutting torch, etc.).
- **Basic Manufacturing Standards:** Understanding of ISO 9000 and 9001 Standards, CMM, DOE, FMEA, Minitab, and process control.
- **Basic Equipment Maintenance/Repair:** Proficiency with equipment assembly, maintenance, efficiency, repair, cleaning, installation, and inspection.

Job Description (Example)

Set up and operate a variety of machine tools to produce precision parts and instruments. Includes precision instrument makers who fabricate, modify, or repair mechanical instruments. May also fabricate and modify parts to make or repair machine tools or maintain industrial machines, applying knowledge of mechanics, mathematics, metal properties, layout, and machining procedures.

- Assemble machine tools, parts, or fixtures and program equipment to perform production tasks.
- Create and review blueprints or other instructions to determine operational methods or sequences.
- Plan production or operational procedures or sequences.
- Operate welding equipment, grinding equipment, and cutting equipment.
- Conduct test runs of production equipment and diagnose equipment malfunctions.
- Advise others on ways to improve processes or products.

Activities (Example List)

- Calculate dimensions or tolerances using instruments such as micrometers or vernier calipers.
- Machine parts to specifications, using machine tools, such as lathes, milling machines, shapers, or grinders.
- Set up, adjust, or operate basic or specialized machine tools used to perform precision machining operations.
- Align and secure holding fixtures, cutting tools, attachments, accessories, or materials onto machines.
- Measure, examine, or test completed units to check for defects and ensure conformance to specifications using precision instruments such as micrometers.
- Monitor the feed and speed of machines during the machining process.
- Maintain machine tools in proper operational condition.
- Study sample parts, blueprints, drawings, or engineering information to determine methods or sequences of operations needed to fabricate products.
- Operate equipment to verify operational efficiency.
- Check work pieces to ensure that they are properly lubricated or cooled.

Prioritized Foundational Competencies: Machinist

Most Common Required Competencies	
1	Active Listening: Giving full attention to what other people are saying to maximize learning from co-workers and supervisors, understanding occupation-specific terms and their practical meaning (e.g., “turn” means use a lathe; “square them up” means use a mill), recognizing that listening is essential to safety in this occupation, and knowing when to ask questions and then asking.
2	Equipment Selection: Can identify and understands the basic functions of the key machinist tools (mills, lathes, grinders, saw, drill press); ability to operate, with some supervision, the saw and drill press to demonstrate needed abilities and to serve as a building block for using the other tools (mill, lathe and grinder).
3	Critical Thinking: Understanding that most products can be made in multiple ways and identifying the most efficient way to make a given piece is important (e.g., use a mill to prepare a piece and then a grinder to finish it); some ability to select the right tool to use given the piece being made and the relevant requirements (e.g., finishing, tolerance) and material.

Most Preferred Competencies	
1	Quality Control Analysis: <i>See previous.</i>
2	Complex Problem Solving: See process from start to finish, take initiative to identify problems and solve them (minimize waste, check feasibility) and choose the most efficient way to produce; able to operate independently with decreasing supervision required over time; proactively maintain tools to optimize efficiency (sharpen tools when dulling).
3	Operation and Control: Follow all rules and parameters; use tools and machines safely and efficiently in a way that does not waste material; monitor machines, process and output to ensure high quality delivery.

Most Evolving Competencies	
1	Complex Problem Solving: Evolution due to emergence of new technologies (machines, quality systems, lean techniques), expanded capabilities and global innovations in production methods; changes increase value of learning on-the-spot, adapting to new innovations and challenging one’s own conceptions.
2	Active Learning: Evolution driven by new machine tools and production methods; changes allow companies to do more with less but at the cost of disruptions to the status quo; changes make it more important to be open-minded to new ways of doing things and to be willing to share new information with others.
3	Judgment and Decision Making: Evolution due to constant emergence of new machine programs and tools; changes present more options to employees considering multiple solutions, tools, processes, etc.; increase value of active learning and complex problem solving skills.

Most Common Break Point Competencies	
1	Quality Control Analysis: Create products that meet specifications (tolerance, finish, dimensions) with an acceptable success rate (“measure twice; cut once”); operate safely and adhere to well-defined processes; demonstrate a quality mindset, “every piece matters”.
2	Active Listening: <i>See previous.</i>
3	Critical Thinking: <i>See previous.</i>

Most Hard-to-Find Competencies	
1	Complex Problem Solving: <i>See previous.</i>
2	Judgment and Decision Making: Able to make decisions independently when appropriate (picking the right machines and using an efficient process to create products) and to get direction when appropriate (for example, when a mistake might be expensive); follows safety protocols and does not take short cuts, which can be risky.
3	Active Learning: <i>See previous.</i>

Prioritized Occupation-Specific Competencies: Machinist

Most Common Required Competencies	
1	Machine Tools: Certification and/or proficiency with machine tools such as power grinders, milling cutters, drill presses, lathes, calipers, tool dies, and their dial indicators.
2	Mathematics: Able to perform basic applied trigonometry (largely triangles, rectangles and cylinders) necessary to solve problems; basic ability to visualize problems in 3-D.
3	Hand Tools: Ability to safely and appropriately use ballpeen hammer, dead-fall hammer, screwdriver, torque wrench, Allen wrench, mill bastard file, and a 6 inch scale.

Most Common Break Point Competencies	
1	Machine Tools: <i>See previous.</i>
2	Mathematics: <i>See previous.</i>
3	Hand Tools: <i>See previous.</i>

Most Preferred Competencies	
1	Machine Tools: <i>See previous.</i>
2	Manufacturing Processes: Basic awareness of key production processes including turning, milling, and drilling; able to measure and document incoming components to validate key parameters and qualities (to ensure high quality).
3	Mathematics: <i>See previous.</i>

Most Hard-to-Find Competencies	
1	Machine Tools: <i>See previous.</i>
2	Mathematics: <i>See previous.</i>
3	Manufacturing Processes: <i>See previous.</i>

Most Evolving Competencies	
1	Manufacturing Processes: Evolution driven by global innovations that allow companies to produce more efficiently; changes place more value on adaptability and active learning skills as employers must continually learn to adapt to new processes.
2	Machine Tools: Evolution driven by emergence of new technology; changes allow for greater output and new manufacturing processes but increase difficulty of machine tool use and maintenance; changes may necessitate new methods of assembly, production and/or machine tool operation; increase value of active learning.
3	Computer-Aided Manufacturing: Evolution due to new computer technology and manufacturing processes; changes will give employees more flexibility and control over output but will increase the difficulty of use; these changes will make it more important to be adaptable.

Occupation Deep Dive: Machinist

Job Titles Within This Occupation

- Machinist
- Manual Machinist
- Journeyman Machinist

Certification and Education Preferences (Example)

- National Institute of Metalworking Skills (NIMS) Certified Machinist
- National Institute of Metalworking Skills (NIMS) Certified Toolmaker
- National Institute of Metalworking Skills (NIMS) Certified CNC Setup Programmer
- National Institute of Metalworking Skills (NIMS) Certified Journey Worker

Tools Used (Example List)

- Computer Numerical Control (CNC)
- Blueprints
- Lathes
- CNC Mill
- Micrometers
- Milling Cutters
- Calipers
- Hand Tools

Other Relevant Foundational Competencies

1	Reading Comprehension
2	Management of Financial Resources
3	Time Management
4	Writing
5	Speaking
6	Social Perceptiveness
7	Troubleshooting
8	Mathematics
9	Instructing
10	Equipment Maintenance
11	Repairing
12	Systems Evaluation
13	Persuasion
14	Negotiation
15	Installation
16	Systems Analysis
17	Learning Strategies
18	Technology Design
19	Service Orientation
20	Operations Analysis
21	Management of Personnel Resources
22	Programming
23	Management of Material Resources
24	Science
25	

Other Relevant Occupation-Specific Competencies

1	General Engineering
2	General Electrical Systems
3	Manufacturing Design
4	Operations Management
5	Industrial Design
6	General Design
7	Circuitry
8	Employee Training
9	Power Tools
10	Material Moving and Transport
11	Product Inspection
12	Packaging
13	Engineering Software
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