

**Duties and Standards  
for**

# **MOLDMAKING AND DIE CASTING DIEMAHER SKILLS**

**LEVEL II**



**Approved By :**



**The National Institute for Metalworking Skills, Inc.**

**Duties and Standards**

**For**

**MOLDMAKING AND DIE CASTING  
DIEMAKER SKILLS**

**LEVEL II**



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The principal author of this skill standards manual is Robert W. Sherman of Robert W. Sherman and Associates, who is the project director of the National Institute for Metalworking Skills, Inc. (NIMS). The technical guidance and financial support that have made these standards possible have been provided by the members of the National Tooling and Machining Association (NTMA), The Society of Plastics Engineers, Inc. (SPE) Moldmakers Division, The Society of the Plastics Industry (SPI) Moldmakers Division, and the Tooling and Manufacturing Association (TMA).

## Overview--Metalworking and the Skill Standards Process

The metalworking industry is fundamental to maintaining a productive industrial capacity in the United States. The industry produces everything from the simplest die or metal mold for plastics to the most sophisticated automated production lines. It designs and builds special tools, dies, jigs, fixtures, molds, diecasting dies, gages, special machinery, wire and spring products, and it bends, stamps, and forms metals to produce precision parts or components. Virtually every manufacturing and service industry draws on or depends upon the skills, capabilities, and products of the metalworking industry.

Because the quality and vitality of the metalworking industry undergirds the industrial capacity of any country, precision metalworking occupations are central to maintaining a high wage and high skill employment base. The metalworking industry has sought to assure that those individuals who would seek to enter into or advance within the industry have opportunity to know and develop the skills which are required. This begins with the writing of skill standards.

Skill standards describe the work duties in an industry. These standards or descriptions define a desired level of performance and identify the knowledge, skills and abilities an individual needs to perform successfully in a workplace. Skill standards focus on the common duties and their performance requirements in the various sub-industries that make up the industry.

The skill standards in metalworking are based on input from workers, employers, trainers, and educators nationwide. Benchmarked to those in Germany, Japan, and other leading metalworking countries, the standards are proposed for broad application in all public and private workforce development programs that prepare youth and adults for employment in metalworking occupations. The standards are also intended for application in upgrading and retraining programs, apprenticeships for those already employed in metalworking companies, and are recommended for benchmarking company-based training programs.

Individuals seeking to master skill standards have opportunities to do so through the credentialing and certification programs offered by the National Institute for Metalworking Skills (NIMS). NIMS is a not-for-profit organization that has responsibility to write and maintain skill standards for the different occupational areas within the metalworking industry. NIMS also develops- and administers credentialing tests leading to a certification of skills. Such certification offers portability to the worker as the skill standards are the same throughout the United States in the respective occupational area.

NIMS represents nearly all aspects of the metalworking industry and trades. Actively participating in NIMS are the following organizations:

American Machine Tool Distributors Association (AMTDA)  
(AMT) Association for Manufacturing Technology  
Center for Workforce Democracy of the AFL-CIO  
Council of Great Lakes Governors (CGLG)  
International Association of Machinists and Aerospace Workers (IAMAW)  
National Precision Machined Products Association (NPMPA)  
National Tooling and Manufacturing Association (NTMA)  
Precision Metalforming Association (PMA)  
The Society of Plastics Engineers, Inc. Moldmakers Division  
The Society of the Plastics Industry, Moldmakers Division (SPI)  
Tooling and Manufacturing Association (TMA)  
Center for Workforce Democracy of the AFL-CIO

Several states and training programs, both public and private, are also involved with NIMS.

Mastering the skills in any of the metalworking clusters offers rewarding careers the opportunities of which go well beyond those of specific machine process mastery, into management, sales, and engineering, and even company ownership and development.

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## **Moldmaking and Die Casting Diemaker Skills—Level II**

### **General Description**

The Level II moldmaker and die casting diemaker builds and assembles molds and casting dies. The skills required to be a moldmaker and die cast diemaker include most of the machining skills found in *Duties and Standards for Machining Skills—Level II*. The list of required machining skills is contained in Appendix A of this document. While as an assembler the worker might not directly use all of these skills, it is important to know and master them. Moldmaking and diemaking begins at Level II in partnership with the Level II machining skill standards. The foundation skills required are the manual machine operations skills called for in *Duties and Standards for Machining Skills—Level I*.

The standards, as written, address the metalworking skills and assembly skills. A worker in this profession at Level II should be able to identify electrical components and read the symbology of electrical, hydraulics and pneumatic systems, and mechanical functions.

### **Occupational Description and Benchmarks**

#### **Occupational Description**

Skills are used by tradespersons who have achieved proficiency in the assembly and manufacture of molds and die casting dies used in industry. Quality skills and strong planning and job control skills are critical in this occupation. The general areas of competency include the following:

- Ability to read engineering drawings and visualize the finished product
- Ability to Identify, measure, and verify precision parts and components
- Ability to work with metric drawings, specifications and conversions
- A high level of proficiency with various machine tools and hand tools
- Inspection and quality assurance skills
- A broad understanding of the operation of mechanical devices
- Inspection and quality assurance skills

#### **Safety and Environment**

Safety and environmental concerns are responsibilities that cut across all competencies. Skilled workers are expected to know and execute correctly all matters pertaining to safety and environment for these competencies. A mold or die cast diemaker with Level II skills may have modest training or supervision responsibilities.

#### **Job Planning Skills**

The first step in providing customer satisfaction and economic efficiencies while utilizing the capabilities available is the development of an organized approach to the construction of the mold. The following are general areas of competency in job planning:

- Review design and determine a manufacturing plan.
- Develop the process and plan to meet the due date.
- Be aware of costs and avoid waste.

**Inspection and Quality Control**

- Follow and document in process inspection.
- Perform trial assemblies to confirm conformance of the components.
- Use precision measuring devices to inspect components.
- Confirm metric dimensions where specified
- Draw up and follow inspection manufacturing plans.

**Other Skills and Competencies**

- Possess a general knowledge and understanding of hydraulic and pneumatic systems.
- Have an understanding of electrical circuitry.
- Have a basic knowledge of plastics molding and die casting processes and machinery.

## Framework for Moldmaking and Die Casting Diemaker Skills—Level II

This figure represents the two principal sets of expectations that comprise Level II skills. The left-hand column is a list of duties that are expected to constitute Level II jobs. The right-hand column is a list of abilities, skills, knowledge, and other characteristics needed to perform the duties.

<b>Occupational Duties</b>	<b>Knowledge, Skills, Abilities, and Other Characteristics</b>
<b>1. Job Planning</b> 1.1 Review Design and Data Sheet 1.2 Develop Initial Manufacturing Plan 1.3 Determine Process to Meet Due Date	<b>1. Written and Oral Communications</b> 1.1 Reading 1.2 Writing 1.3 Speaking 1.4 Listening
<b>2. Mold or Die Casting Die Construction</b> 2.1 Lay Out Work Pieces 2.2 Perform Rough Machining 2.3 Determine Heat Treating Requirements	<b>2. Mathematics</b> 2.1 Arithmetic 2.2 Applications of Geometry 2.3 Applications of Algebra 2.4 Applications of Trigonometry
<b>3. Specialized Machining</b> 3.1 Operate Gun Drill 3.2 Operate Jig Grinder 3.3 Select EDM Machine and Produce Electrodes 3.4 Operate Conventional EDM Machine 3.5 Perform Finish Machining and Prefit Components	<b>3. Decision Making and Problem Solving</b> 3.1 Applying Decision Rules 3.2 Basic Problem Solving
<b>4. Specialized Operation</b> 4.1 Identify, Polish, and Mirror Finish Product 4.2 Texture Mold Surfaces	<b>4. Social Skills and Personal Qualities</b> 4.1 Social Skills 4.2 Personal Qualities
<b>5. Mold or Die Casting Die Preassembly</b> 5.1 Preassemble Base	<b>5. Engineering Drawings and Sketches</b> 5.1 Standard Orthographic Prints 5.2 Schematic Drawings and Layouts 5.3 Assembly Drawings
<b>6. Assembly</b> 6.1 Install Waterlines for Cooling and Heating 6.2 Install Ejector Pins and Return Pins 6.3 Install Necessary Hardware	<b>6. Measurement</b> 6.1 Basic Measuring Instruments 6.2 Precision Measuring Instruments 6.3 Surface Plate Instruments 6.4 Metric Measurement and Conversion
	<b>7. Metalworking Theory</b> 7.1 Cutting Theory 7.2 Tooling 7.3 Material Properties—Mold Construction 7.4 Machine Tools 7.5 Cutting Fluids and Coolants
	<b>9. Machine Controls</b> 9.1 Computer Controls
	<b>10. Safety, Health, and Environment</b> 10.1 Material Safety Data Sheets 10.2 Safe Operating Practices

**Duty Area:** 1. **Job Planning**  
**Duty Title:** 1.1 **Review Design and Data Sheet**

***Duty:***

Review data to confirm that all needed information is given.

***Performance Standard:***

Given a mold or die cast die design, a part design, and a set of data sheets, confirm that project specifications and requirements are clearly stated on the job manufacturing plan. Clarify the mold or die casting function. Review the design with engineering to confirm final requirements. Recommend changes or additions that will improve machining and building capabilities if needed.

***Accuracy Level:***

N/A

***Assessment Equipment and Material:***

*Workstation:* Workbench

*Materials:* N/A

*Tooling:* N/A

*Measuring Instruments:* Ruler, protractor, and common measuring instruments

*References:* Manufacturing plan, prints, and part specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Review Design and Data Sheet Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading		6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:** 1. Job Planning  
**Duty Title:** 1.2 Develop Initial Manufacturing Plan

***Duty:***

Prepare a plan for completion of the job.

***Performance Standard:***

Given a mold or die cast die to be made, establish a method of operation. Determine most efficient machine use and required tooling. Identify and confirm availability of proper materials and components, appropriate fixtures, and holding devices. Identify areas that will need a secondary process.

***Accuracy Level:***

N/A

***Assessment Equipment and Material:***

*Workstation:* N/A

*Materials:* As required on specification sheets

*Tooling:* N/A

*Measuring Instruments:* N/A

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Develop Initial Manufacturing Plan Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic		7.1 Cutting Theory
X	2.2 Applications of Geometry		7.2 Tooling
X	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:** 1. Job Planning  
**Duty Title:** 1.3 Determine Process to Meet Due Date

***Duty:***

Determine production schedule.

***Performance Standard:***

After development of the construction plan, verify availability and scheduling of machines to be used and any special operations or components that may be outsourced in order to meet the due date for completion of the mold or die casting die.

***Accuracy Level:***

N/A

***Assessment Equipment and Material:***

*Workstation:* N/A

*Materials:* As specified on manufacturing plan

*Tooling:* N/A

*Measuring Instruments:* N/A

*References:* Manufacturing plan, prints, and mold specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Determine Process to Meet Due Date Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading		6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic		7.1 Cutting Theory
	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:**            **2.     Mold or Die Casting Die Construction**  
**Duty Title:**         **2.1    Lay Out Work Pieces**

***Duty:***

Lay out work pieces to establish the working plane.

***Performance Standard:***

Refer to drawings and establish the working plane. Use proper layout aides and precision measuring instruments.

***Accuracy Level:***

N/A

***Assessment Equipment and Material:***

*Workstation:*    Workbench

*Materials:*     As specified on manufacturing plan

*Tooling:*        N/A

*Measuring Instruments:* Height gage, combination square, caliper, planer gauge, gauge block, protractor, micrometers, scale, and flat surface

*References:*    Manufacturing plan, part data sheet, and prints

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Lay Out Work Pieces Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing	X	6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area: 2. Mold or Die Casting Die Construction**  
**Duty Title: 2.2 Perform Rough Machining**

***Duty:***

Complete rough machining of parts.

***Performance Standard:***

Perform rough machining identifying the correct working plane, correct combination of machining processes, and proper speeds and feeds. Produce cores, cavities, and mold components to rough tolerances and inspect to dimensions as specified on the job manufacturing plan.

***Accuracy Level:***

Rough machining tolerances as specified on the prints, drawings, and manufacturing plan

***Assessment Equipment and Materials:***

*Workstation:* Machine shop

*Materials:* As specified on manufacturing plan

*Tooling:* Machine tools

*Measuring Instruments:* Scales, micrometers, depth micrometers, calipers, and dial indicator

*References:* Manufacturing plan, prints, and parts drawings

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Perform Rough Machining Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing	X	6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry	X	7.2 Tooling
X	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry	X	7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>	X	7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:** 2. **Mold or Die Casting Die Construction**  
**Duty Title:** 2.3 **Determine Heat Treating Requirements**

***Duty:***

Determine heat treating requirements.

***Performance Standard:***

Prepare required components for heat treating. Upon receiving the components sent for heat treating, inspect, confirm, and record hardness confirmed by using a hardness tester.

***Accuracy Level:***

Appropriate scale per Rockwell C or Brinell hardness as specified

***Assessment Equipment and Materials:***

*Workstation:* N/A

*Materials:* As specified on manufacturing plan

*Tooling:* N/A.

*Measuring Device:* Hardness tester

*References:* Manufacturing plan and heat treating manual

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Determine Heat Treating Requirements Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading		6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
	2.1 Arithmetic		7.1 Cutting Theory
	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:**            **3.    Specialized Machining**  
**Duty Title:**           **3.1   Operate Gun Drill**

***Duty:***

Set up and operate a gun drill.

***Performance Standard:***

Given a hole 12 or more inches deep to be drilled, set up a gun drill, calculate the proper speed and feed, and drill hole as specified.

***Accuracy Level:***

.001 run-out per linear inch

***Assessment Equipment and Materials:***

*Workstation:* Gun drill

*Materials:* As specified on manufacturing plan

*Tooling:* Gun drill accessories

*Measuring Instruments:* Scales, depth micrometers, calipers, micrometer, bore gage, and plug gage

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Operate Gun Drill Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry	X	7.2 Tooling
X	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
X	2.4 Applications of Trigonometry	X	7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>	X	7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:** 3. Specialized Machining  
**Duty Title:** 3.2 Operate Jig Grinder

***Duty:***

Set up and operate a jig grinder.

***Performance Standard:***

Set up and operate a jig grinder. Inspect, mount, and dress wheel, and grind components to specifications.

***Accuracy Level:***

+/-1/10th of print specifications

***Assessment Equipment and Material:***

*Workstation:* Jig grinder

*Materials:* As specified on manufacturing plan

*Tooling:* Jig grinding accessories

*Measuring Instruments:* Scales, depth micrometers, calipers, dial indicators, gage blocks, and dial bore gage

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Operate Jig Grinder Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing	X	6.2 Precision Measuring Instruments
X	1.3 Speaking	X	6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry	X	7.2 Tooling
X	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
X	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:**            **3.    Specialized Machining**  
**Duty Title:**           **3.3   Select EDM Machine and Produce Electrodes**

***Duty:***

Produce plunge EDM electrodes.

***Performance Standard:***

Given a mold or casting die to be built, select EDM machine, and determine proper electrode material based on part configuration and finish requirements. Select a tooling system using conventional machining techniques, determine proper flushing method, and produce the number of electrodes to size as required.

***Accuracy Level:***

Part design and specifications

***Assessment Equipment and Materials:***

*Workstation:*   Machine tools

*Materials:*     Electrode material as required for part size and finish

*Tooling:*       Machine tools and holding devices

*Measuring Instruments:* Scales, depth micrometers, calipers, gage blocks, dial indicators,  
and sine plate

*References:*    Manufacturing plan, prints, machine technology charts, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Select EDM Machine and Produce Electrodes Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing	X	6.2 Precision Measuring Instruments
X	1.3 Speaking	X	6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry		7.2 Tooling
X	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
X	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:**            **3.    Specialized Machining**  
**Duty Title:**           **3.4   Operate Conventional EDM Machine**

***Duty:***

Operate a conventional plunge EDM machine.

***Performance Standard:***

Given a manufacturing plan and the appropriate electrode(s), set up and operate a conventional EDM machine and produce cavities and cores.

***Accuracy Level:***

Part specifications

***Assessment Equipment and Materials:***

*Workstation:* Conventional EDM machine

*Materials:* As specified on manufacturing plan

*Tooling:* EDM electrode and holding devices

*Measuring Instruments:* Scales, depth micrometers, calipers, verniers, gage blocks, sine plate, dial indicators, and toolmaker's microscope

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Operate Conventional EDM Machine Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing	X	6.2 Precision Measuring Instruments
X	1.3 Speaking	X	6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry	X	7.2 Tooling
X	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area: 3. Specialized Machining**  
**Duty Title: 3.5 Perform Finish Machining and Prefit Components**

***Duty:***

Perform finish machining to part size.

***Performance Standard:***

Using a combination of machining processes, perform finish machining. Identify the correct working plane. Produce all components to finished tolerances. Compare components to print specifications. Before beginning trial assembly, prefit components and verify the fit of cavities and cores, inserts, slides, retractors, lifters, and wedge bars. Confirm and correct, as needed, parting lines. Machine or hand grind vents required for degassing material. Cut and grind ejector (knock-out) pins.

***Accuracy Level:***

Required machine finishes of cavities and cores and other components as specified on the manufacturing plan

***Assessment Equipment and Materials:***

*Workstation:* Machine tools as required

*Materials:* As specified on manufacturing plan

*Tooling:* Hand tools, special files, grinding tools, stone, and milling machine

*Measuring Instruments:* Scales, depth micrometers, calipers, gage blocks, sine plate, profilometer, and dial indicator

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Perform Finish Machining and Prefit Components Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing	X	6.2 Precision Measuring Instruments
X	1.3 Speaking	X	6.3 Surface Plate Instruments
X	1.4 Listening	X	6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic	X	7.1 Cutting Theory
X	2.2 Applications of Geometry	X	7.2 Tooling
X	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
X	2.4 Applications of Trigonometry	X	7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>	X	7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area: 4. Specialized Operation**  
**Duty Title: 4.1 Identify, Polish, and Mirror Finish Product**

***Duty:***

Identify components, engrave, and polish.

***Performance Standard:***

Stamp or engrave product identification numbers on cavities, cores, and bases. Select the proper stone and hand stone cavity surfaces. Hand polish cavity surface with progressively finer abrasives including diamond compounds to obtain desired microinch finish.

***Accuracy Level:***

As specified on drawings and manufacturing plan

***Assessment Equipment and Material:***

*Workstation:* Workbench

*Materials:* As specified on manufacturing plan

*Tooling:* Stones, polishing medium, diamond compounds, emery cloth, and other polishing tools

*Measuring Instruments:* Ruler, protractor, scales, and common measuring instruments

*References:* SPI Finishes Kit

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Identify, Polish, and Mirror Finish Product Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic		7.1 Cutting Theory
	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:** 4. Specialized Operation  
**Duty Title:** 4.2 Texture Mold Surfaces

***Duty:***

Apply a pattern or texture to a mold surface.

***Performance Standard:***

Given a specialty pattern or texture for the surface of a molded part, use the proper method and process and complete the surface finish of the cavity to produce the required texture, or if needed, prepare the work order and detailed requirements in order to send the cavities out to be surfaced as required.

***Accuracy Level:***

As specified on drawings and manufacturing plan

***Assessment Equipment and Material:***

*Workstation:* Workbench

*Materials:* As specified on manufacturing plan

*Tooling:* Engraving and texturing tools

*Measuring Instruments:* Ruler, protractor, scales, and common measuring instruments

*References:* Customers specifications and SPI Finishes Kit

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Texture Mold Surfaces Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing	X	6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
	2.1 Arithmetic		7.1 Cutting Theory
	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area: 5. Mold or Die Cast Die Pre-assembly**

**Duty Title: 5.1 Pre-assemble Base**

***Duty:***

Preassemble mold or die base.

***Performance Standard:***

Pre-assemble base, insert cores and cavities, and verify all working fits. Conduct final spotting of the pre-assembly for fit of all components. Confirm parting lines and closing. Disassemble and polish.

***Accuracy Level:***

N/A

***Assessment Equipment and Materials:***

*Workstation:* Workbench and machine shop

*Materials:* Mold or casting die base and components

*Tooling:* N/A

*Measuring Instruments:* Scales, depth micrometers, and calipers

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Pre-assemble Base Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic		7.1 Cutting Theory
X	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra	X	7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving		8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:** 6. Assembly

**Duty Title:** 6.1 Install Waterlines for Cooling and Heating

***Duty:***

Install waterlines for cooling or heating.

***Performance Standard:***

Install waterline components and inspect for cooling or heating. Pressure test for leaks and conduct a flow test.

***Accuracy Level:***

N/A

***Assessment Equipment and Materials:***

*Workstation:* Workbench

*Materials:* As specified on manufacturing plan

*Tooling:* Hand tools

*Measuring Instruments:* Flow and pressure tester

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Install Waterlines for Cooling and Heating Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading		6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
	2.1 Arithmetic		7.1 Cutting Theory
	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving	X	8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area:** 6. Assembly  
**Duty Title:** 6.2 Install Ejector Pins and Return Pins

***Duty:***

Install ejector system.

***Performance Standard:***

Given a mold guiding system, install part ejector pins and ejector return mechanisms.

***Accuracy Level:***

N/A

***Assessment Equipment and Materials:***

*Workstation:* Workbench

*Materials:* As specified on manufacturing plan

*Tooling:* Hand tools

*Measuring Instruments:* Ruler, protractor, scales, depth micrometers, calipers, and dial indicators

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Install Ejector Pins and Return Pins Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading	X	6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
X	2.1 Arithmetic		7.1 Cutting Theory
X	2.2 Applications of Geometry		7.2 Tooling
X	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving	X	8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities	X	<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints		10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		

**Duty Area: 6. Assembly**

**Duty Title: 6.3 Install Necessary Hardware**

***Duty:***

As part of final assembly, install all special hardware.

***Performance Standard:***

Given a mold to be assembled, install necessary hardware such as brackets and clamping devices. Verify that all safety devices are properly installed and working.

***Accuracy Level:***

N/A

***Assessment Equipment and Materials:***

*Workstation:* Workbench

*Materials:* As specified on manufacturing plan

*Tooling:* Hand tools

*Measuring Instruments:* Ruler, protractor, scales, depth micrometers, calipers, and common measuring instruments

*References:* Manufacturing plan, prints, and specification sheets

**KSAO:**

This table represents the kinds of knowledge, skills, abilities, and other characteristics that will be assessed in the performance of the Install Necessary Hardware Duty.

	<b>1. Written and Oral Communications</b>		<b>6. Measurement</b>
X	1.1 Reading		6.1 Basic Measuring Instruments
X	1.2 Writing		6.2 Precision Measuring Instruments
X	1.3 Speaking		6.3 Surface Plate Instruments
X	1.4 Listening		6.4 Metric Measurement and Conversion
	<b>2. Mathematics</b>		<b>7. Metalworking Theory</b>
	2.1 Arithmetic		7.1 Cutting Theory
	2.2 Applications of Geometry		7.2 Tooling
	2.3 Applications of Algebra		7.3 Material Properties—Mold Construction
	2.4 Applications of Trigonometry		7.4 Machine Tools
	<b>3. Decision Making and Problem Solving</b>		7.5 Cutting Fluids and Coolants
X	3.1 Applying Decision Rules		<b>8. Materials Processing</b>
X	3.2 Basic Problem Solving	X	8.1 Plastics and Die Casting Machines
	<b>4. Social Skills and Personal Qualities</b>		<b>9. Machine Controls</b>
X	4.1 Social Skills		9.1 Computer Controls
X	4.2 Personal Qualities		<b>10. Safety, Health, and Environment</b>
	<b>5. Engineering Drawings and Sketches</b>	X	10.1 Material Safety Data Sheets
X	5.1 Standard Orthographic Prints	X	10.2 Safe Operating Practices
X	5.2 Schematic Drawings and Layouts		
X	5.3 Assembly Drawings		



## **Knowledge, Skills, Abilities, and Other Characteristics**

**KSAO Area: 1. Written and Oral Communications**  
**KSAO: 1.1 Reading**

***KSAO Definition:***

Locates, understands, and interprets written technical and nontechnical information in documents commonly found in the metalworking industry. These documents contain short and simple sentences, paragraphs and passages, phrases, quantitative information, specialized vocabulary, graphs, charts, schedules, simple instructions, and multistep directions. All documents are written in standard English.

***Performance Requirement:***

Given a specific duty to perform and the necessary written information contained on relevant documents and information sheets, locate and read the necessary information and use this information to plan, execute, and evaluate the duty and answer questions about the content or meaning of the written information.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Reading KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Read prints. Read tool crib inventory. Read handbook.
2. Job execution	Benchwork Layout	Read prints. Read manufacturing plans.
3. Quality and inspection	Inspection control	Read prints. Read inspection plan. Read sampling plan. Read charting instructions.
4. Process improvement	Process adjustment Participation in improvement	Read prints. Read manufacturing plan. Read handbook. Read team documents.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Read checklist. Read manuals.
6. Safety and environment	Operations and handling HazMat handling and storage Material storage	Read safety instructions.

**KSAO Area: 1. Written and Oral Communications**

**KSAO: 1.2 Writing**

***KSAO Definition:***

Communicates technical and nontechnical information, messages, and ideas in writing using standard English commonly found in the metalworking industry. This writing includes the completion of forms, information sheets, reports, group meeting materials, and short memos.

***Performance Requirement:***

Given a specific duty to perform and the necessary instructions, forms, and materials to complete the writing requirements for that duty, complete the writing requirement.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Writing KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Write instructions on the manufacturing plan.
2. Job execution	Benchwork Layout Operation of machine tools	Write record of job activities.
3. Quality and inspection	Inspection control	Write record of inspection activities.
4. Process improvement	Process adjustment Participation in improvement	Write record of adjustment and improvement activities.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Write record of maintenance activities. Fill out history forms.
6. Safety and environment	Operations and handling HazMat handling and storage Material storage	Write record of the activities involving the handling and storage of standard and hazardous materials.

**KSAO Area: 1. Written and Oral Communications**  
**KSAO: 1.3 Speaking**

***KSAO Definition:***

Communicates technical and nontechnical detailed information, messages, multistep directions, and ideas through oral communication using standard English and related cues and communication aids in conversations, discussions, and group meetings. Understands and responds to listener feedback and asks questions when needed in two-way and group conversations.

***Performance Requirement:***

Given a specific duty to perform and the necessary instructions, written documents, and communication aids and materials to complete the speaking requirements for that duty, complete the speaking requirement.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Speaking KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Explain manufacturing plan.
2. Job execution	Benchwork Layout Operation of machine tools	Explain job execution activities.
3. Quality and inspection	Inspection control	Explain inspection procedures.
4. Process improvement	Process adjustment Participation in improvement	Propose process remedies. Explain suggested corrective action. Explain fishbone charts. Explain root cause reasoning.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Explain the condition of machine tools and the maintenance action taken.
6. Safety and environment	Operations and handling HazMat handling and storage Material storage	Explain actions bearing on safe practice.

**KSAO Area: 1. Written and Oral Communications**  
**KSAO: 1.4 Listening**

***KSAO Definition:***

Listens for, receives, interprets, and recalls specific details, ideas, and multistep instructions in verbal presentations, conversations, discussions, and group meetings conducted in standard English and supported by written materials and other communication cues and aids. Uses active listening skills in comprehending simple technical and nontechnical verbal information.

***Performance Requirement:***

Given a specific duty to perform and the necessary written information contained on relevant documents and information sheets, listen for, comprehend, and incorporate oral information in the performance of the duty and answer questions about the content or meaning of the oral information.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Listening KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Listen to verbal instructions.
2. Job execution	Benchwork Layout Operation of machine tools	Listen to verbal instructions.
3. Quality and inspection	Inspection control	Listen to verbal instructions.
4. Process improvements	Process adjustment Participation in improvement	Listen to verbal instructions.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Listen to verbal instructions.
6. Safety and environment	Operations and handling HazMat handling and storage Material storage	Listen to verbal instructions.

**KSAO Area: 2. Mathematics**  
**KSAO: 2.1 Arithmetic**

***KSAO Definition:***

Performs addition, subtraction, multiplication, and division of whole numbers without a calculator, and performs calculation of fractions and decimals, as well as conversion to metric measurement with or without a calculator.

***Performance Requirement:***

Given a specific duty to perform requiring arithmetic operations, conduct arithmetic operations.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Arithmetic KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Calculate speeds and feeds. Calculate operation times.
2. Job execution	Benchwork Layout Operation of machine tools	Calculate necessary dimensions from the print.
3. Quality and inspection	Inspection Control	Calculate necessary dimensions from the print. Calculate statistics required by control charts.
4. Process improvement	Process adjustment Participation in improvement	Calculate the impact of a change of speed or feed.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Calculate the length of time spent in a PM activity.
6. Safety and environment	Operations and handling HazMat handling & storage Material storage	Calculate the volume of material stored.

**KSAO Area: 2. Mathematics**  
**KSAO: 2.2 Applications of Geometry**

***KSAO Definition:***

Understands and applies basic geometric concepts and terminology which form the analytical foundation of job planning and execution including planes perpendicularity, Cartesian coordinates, concentricity, parallelism, straightness, flatness, circularity, and symmetry.

***Performance Requirement:***

Given a specific duty to perform requiring the understanding and use of geometric concepts and terminology, perform the required duty and answer questions about the meaning and use of the geometric principles.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Applications of Geometry KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Apply geometry to select and sequence operations.
2. Job execution	Benchwork Layout Operation of machine tools	Apply geometry to hold work appropriately. Apply geometry to produce surfaces correctly.
3. Quality and inspection	Inspection Control	Apply geometry to locate surfaces and centerlines.
4. Process improvement	Process adjustment Participation in improvement	Apply geometry in analyzing operations and sequences.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Apply geometry in troubleshooting a machine tool or cutting tool.

**KSAO Area:**        **2.     Mathematics**  
**KSAO:**               **2.3    Applications of Algebra**

***KSAO Definition:***

Uses standard formulas and arithmetic operations to make required calculations with or without a calculator. Can solve for an unknown in a trade formula.

***Performance Requirement:***

Given a specific duty to perform requiring the use of formulas and arithmetic operations, conduct the required arithmetic operations using standard formulas.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Applications of Algebra KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Use trade formulas.
2. Job execution	Benchwork Layout Operation of machine tools	Use trade formulas.
3. Quality and inspection	Inspection Control	Use trade formulas.

**KSAO Area: 2. Mathematics**  
**KSAO: 2.4 Applications of Trigonometry**

***KSAO Definition:***

Uses standard formulas and arithmetic operations to make required calculations with or without a calculator, solving for unknowns in right triangles.

***Performance Requirement:***

Given a specific duty to perform requiring the use of formulas and arithmetic operations, conduct the required arithmetic operations using standard formulas.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Applications of Trigonometry KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Use trig-based trade formulas.
2. Job execution	Benchwork Layout Operation of machine tools	Use trig-based trade formulas.
3. Quality and inspection	Inspection Control	Use trig-based trade formulas.

**KSAO Area: 3. Decision Making and Problem Solving**  
**KSAO: 3.1 Applying Decision Rules**

***KSAO Definition:***

Can follow a set of instructions laid out in a sequence. Can interpret and follow "if... then...." instructions.

***Performance Requirement:***

Given a specific duty to perform requiring a checklist of sequential instructions, carry out the duty making appropriate entries on the checklist.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Applying Decision Rules KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Sequence operations.
2. Job execution	Benchwork Layout Operation of machine tools	Follow the manufacturing plan, deviating according to decision rules where necessary.
3. Quality and inspection	Inspection Control	Follow the quality plan, deviating according to decision rules where necessary.
4. Process improvement	Process adjustment Participation in improvement	Apply checklists and decision rules to process improvement.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Apply company procedures to housekeeping, PM, and TM.
6. Safety and environment	Operations and handling HazMat handling & storage Material storage	Apply OSHA and EPA decision rules to the storage and handling of materials.

**KSAO Area: 3. Decision Making and Problem Solving**  
**KSAO: 3.2 Basic Problem Solving**

***KSAO Definition:***

Can establish new responses to unexpected problems of a simple nature. Can formulate the new responses into a sequence of instructions or a set of "if... then ...." rules.

***Performance Requirement:***

Given a specific duty to perform and being furnished with a checklist of sequential instructions, carry out the duty according to the checklist responding appropriately to problems. Formulate those responses into "if... then...." rules.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Basic Problem Solving KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Sequence operations, providing alternatives according to availability of tools and equipment.
2. Job execution	Benchwork Layout Operation of machine tools	Follow a manufacturing plan, improvising new methods where unavailability of tooling makes the plan obsolete.

**KSAO Area: 4. Social Skills and Personal Qualities**

**KSAO: 4.1 Social Skills**

***KSAO Definition:***

Identifies and demonstrates the appropriate social skills and related personal qualities in the performance of major duties requiring cooperative relations with supervisors, team leaders, and team members.

***Performance Requirement:***

Demonstrate understanding, friendliness, politeness, and empathy toward others, including people of different genders and those from a variety of ethnic, social, and educational backgrounds. Work cooperatively with others and contribute to group efforts with ideas, suggestions, and positive feedback to group members. Demonstrate appropriate social and communication skills in resolving conflicts with supervisors, team leaders, and team members.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Social Skills KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Work cooperatively in developing a manufacturing plan, taking input from supervisors and co-workers.
2. Job execution	Benchwork Layout Operation of machine tools	Work cooperatively by responding to the need to share common work spaces.
3. Quality and inspection	Inspection Control	Work cooperatively by participating in cooperative SPC activities.
4. Process improvement	Process adjustment Participation in improvement	Work cooperatively in workgroups, developing process improvements.
5. Maintenance	Housekeeping Machine tool PM Tooling maintenance	Work cooperatively by returning common tools to their appropriate storage sites.

**KSAO Area: 4. Social Skills and Personal Qualities**

**KSAO: 4.2 Personal Qualities**

***KSAO Definition:***

Identifies and demonstrates the appropriate personal qualities in performing major job duties and maintaining positive employment relations.

***Performance Requirement:***

Recognize and demonstrate appropriate codes of conduct and values in the workplace and demonstrate honesty and integrity in exhibiting appropriate workplace behaviors. Assume responsibility and demonstrate strong work ethic by exerting effort and perseverance in doing work tasks according to high standard. Maintain high standard of attendance, punctuality, and involvement in all major work tasks.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Personal Qualities KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
3. Quality and inspection	Inspection Control	Demonstrate honesty and integrity in reporting the findings of inspection processes.
4. Process improvement	Process adjustment Participation in improvement	Demonstrate attendance and punctuality in attending meetings for the development of process improvement.
6. Safety and environment	Operations and handling HazMat handling & storage Material storage	Demonstrate honesty and perseverance in handling materials according to EPA requirements.

**KSAO Area: 5. Engineering Drawings and Sketches**  
**KSAO: 5.1 Standard Orthographic Prints**

***KSAO Definition:***

Interprets standard orthographic prints.

***Performance Requirement:***

Given a standard print and a finished part from that print, prepare a checklist of dimensions necessary to determine the part's compliance.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Standard Orthographic Prints KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Gather geometric and dimensional data from a print to sequence operations.
2. Job execution	Benchwork Layout Operation of machine tools	Gather geometric and dimensional data from a print to perform a layout.
3. Quality and inspection	Inspection Control	Gather geometric and dimensional data from a print to carry out the inspection of a finished part.

**KSAO Area: 5. Engineering Drawings and Sketches**  
**KSAO: 5.2 Schematic Drawings and Layouts**

***KSAO Definition:***

Interprets schematic drawings and layouts.

***Performance Requirement:***

Given schematic drawings and layouts and a finished part from that print, prepare a checklist of dimensions necessary to determine the part's compliance.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Schematic Drawings and Layouts KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Gather geometric and dimensional data from a schematic drawing to sequence operations.
2. Job execution	Benchwork Layout Operation of machine tools	Gather geometric and dimensional data from a schematic drawing to perform a layout.
3. Quality and inspection	Inspection Control	Gather geometric and dimensional data from a schematic drawing to carry out the inspection of a finished part.

**KSAO Area: 5. Engineering Drawings and Sketches**  
**KSAO: 5.3 Assembly Drawings**

***KSAO Definition:***

Interprets assembly drawings.

***Performance Requirement:***

Given assembly drawings and a finished part from that print, prepare a checklist of dimensions necessary to determine the part's compliance.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Assembly Drawings KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Gather geometric and dimensional data from a assembly drawing to sequence operations.
2. Job execution	Benchwork Layout Operation of machine tools	Gather geometric and dimensional data from a assembly drawing to perform a layout.
3. Quality and inspection	Inspection Control	Gather geometric and dimensional data from an assembly drawing to carry out the inspection of a finished part.

**KSAO Area: 6. Measurement**  
**KSAO: 6.1 Basic Measuring Instruments**

***KSAO Definition:***

Recognizes and applies basic measuring instruments such as rules, protractors, inside and outside calipers, and dial indicators.

***Performance Requirement:***

Given a print and a finished part from that print as well as a selection of appropriate basic measuring instruments, determine a part's compliance on selected dimensions.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Basic Measuring Instruments KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
2. Job execution	Benchwork Layout Operation of machine tools	Set the length of layout tools using basic measuring instruments.
3. Quality and inspection	Inspection Control	Inspect dimensions, that call for the use of basic measuring tools on a finished part.

**KSAO Area: 6. Measurement**  
**KSAO: 6.2 Precision Measuring Instruments**

***KSAO Definition:***

Recognizes and applies precision measuring instruments such as micrometers, vernier, dial and electronic calipers, dial indicators; and precision transfer tools such as telescoping gages and adjustable parallels.

***Performance Requirement:***

Given a print and a finished part from that print, as well as a selection of calibrated precision tools, determine a part's compliance on selected dimensions.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Precision Measuring Instruments KSAO.

Duty Area	Task	Activity
2. Job execution	Benchwork Layout Operation of machine tools	Determine the concentricity of a turned part to a lathe's spindle using a dial indicator.
3. Quality and inspection	Inspection Control	Inspect the dimensions of a finished part that call for the use of precision measuring instruments.

**KSAO Area: 6. Measurement**  
**KSAO: 6.3 Surface Plate Instruments**

***KSAO Definition:***

Recognizes and applies appropriately precision tools and instruments for surface plate work such as precision angle plates and tool blocks, precision transfer gages, and precision height gages.

***Performance Requirement:***

Given a print and a finished part from that print, as well as a surface plate and a selection of appropriate surface plate instruments, determine a part's compliance on selected dimensions.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Surface Plate Instruments KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
3. Quality and inspection	Inspection Control	Inspect a part using surface plate instruments.

**KSAO Area: 6. Measurement**

**KSAO: 6.4 Metric Dimensions and Conversions**

***KSAO Definition:***

Able to convert English measurement into metrics and metric dimensions into English measurements

***Performance Requirement:***

Given a print with all dimensions in metrics, convert these dimensions to fractions and inches with or without a calculator.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Metric Dimensions and Conversions KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job Planning	Develop a mold assembly plan	Convert metric measurement to fractions and inches

**KSAO Area: 7. Metalworking Theory**

**KSAO: 7.1 Cutting Theory**

***KSAO Definition:***

Understands and can explain the ideas of heat, shock, friction, zone of distortion, cutting interface, machinability, cutter presentation, cutter geometry, and chip-holding capacity as they relate to machining applications.

***Performance Requirement:***

Given a print and a part to be made, select speeds, feeds, and appropriate tooling to carry out the manufacture of the part.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Cutting Theory KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Determine speeds and feeds.
2. Job execution	Benchwork Layout Operation of machine tools	Select cutters appropriate to machine operations.

**KSAO Area:** 7. **Metalworking Theory**  
**KSAO:** 7.2 **Tooling**

***KSAO Definition:***

Recognizes a wide variety of cutting tools, tool-holding devices, and work-holding devices.  
Understands the appropriate application of these cutters and devices.

***Performance Requirement:***

Given a print and a part to be made, select appropriate tooling, tool-holders, and work-holding devices to carry out the manufacture of the part.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Tooling KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
2. Job execution	Benchwork Layout Operation of machine tools	Select cutters, tool-holders, and work-holders appropriate to machine operations.

**KSAO Area: 7. Metalworking Theory**  
**KSAO: 7.3 Material Properties—Mold Construction**

***KSAO Definition:***

Recognizes common materials and their principal properties relevant to machining tasks. Recognizes differences between ferrous and nonferrous, magnetic, and ductile materials. Understands the changes, that heat-treat imparts to materials.

***Performance Requirement:***

Given a print and a part to be manufactured, predict its machinability based upon its appearance, callout on the print, and its supplied hardness value.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Material Properties—Mold Construction KSAO.

Duty Area	Task	Activity
1. Job planning	Preparation of manufacturing plan	Predict speeds and feeds, as well as tooling requirements, based on known properties of a material.
2. Job execution	Benchwork Layout Operation of machine tools	Respond to cutting conditions imposed by material properties as predicted by the manufacturing plan and actually experienced in machining the material.

**KSAO Area: 7. Metalworking Theory**

**KSAO: 7.4 Machine Tools**

***KSAO Definition:***

Recognizes the common classes of machine tools, understands the function of the major subsystems of machine tools, and selects and applies a given machine tool appropriately.

***Performance Requirement:***

Given a selection of machine tools, a print, and a part to be machined, identify the appropriate machine. Explain the selection and what distinguished that choice from the other possibilities.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Machine Tools KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Select appropriate machine tools for a given set of operations.
2. Job execution	Benchwork Layout Operation of machine tools	Operate machine tools to execute a specific operation.
3. Quality and inspection	Inspection Control	Participate in a machine-capability study.

**KSAO Area: 7. Metalworking Theory**  
**KSAO: 7.5 Cutting Fluids and Coolants**

***KSAO Definition:***

Recognizes, selects, and applies appropriate coolants and coolant delivery systems.

***Performance Requirement:***

Given a set of machining operations, identify the appropriate coolant and delivery system for the operations.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Cutting Fluids and Coolants KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of manufacturing plan	Select appropriate coolants and delivery systems for a given set of operations.
2. Job execution	Benchwork Layout Operation of machine tools	Operate machine tools to execute a specific operation using specified coolants and coolant delivery systems.

**KSAO Area: 8. Materials Processing**  
**KSAO: 8.1 Plastics and Die Casting Machines**

***KSAO Definition:***

Recognizes and can identify the various molding operations.

***Performance Requirement:***

Given a mold or die cast die to build, can explain the type of molding process to be used and identify usual material used for mold construction in different processes.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require understanding the Plastics and Die Casting Machines KSAO.

Duty Area	Task	Activity
1. Job Planning	Development of schedule to build a mold or die casting die	Create a mold construction plan.
2. Job Execution	Building a mold or die casting die	Follow mold construction plan.

**KSAO Area: 9. Machine Controls**  
**KSAO: 9.1 Computer Controls**

***KSAO Definition:***

Is able to describe and understand the control language for computer driven systems.

***Performance Requirement:***

Given a common computer control language, is able to describe the specific functions and the language commands that control the function.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require a knowledge of the Computer Controls KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
2. Job execution	Mold or die casting die construction	Using specified machine control language, set up or verify control functions.

**KSAO Area: 10. Safety, Health, and Environment**  
**KSAO: 10.1 Material Safety Data Sheets**

***KSAO Definition:***

Has a knowledge of the hazards of materials used in the operation of machine tools. Can identify and explain the purpose and information contained in material safety data sheets.

***Performance Requirement:***

Is able to explain the proper handling and disposal of toxic and other potentially hazardous materials such as certain types of cutting fluids, coolants, and lubricants.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Material Safety Data Sheets KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of plan for handling and storage of hazardous materials	Review and identify hazardous materials used on the job.

**KSAO Area: 10. Safety, Health, and Environment**  
**KSAO: 10.2 Safe Operating Practices**

***KSAO Definition:***

Has a knowledge of and can explain safe operating practices.

***Performance Standard:***

Is familiar with and can explain the requirements of the following safety standards and regulations: all applicable OSHA requirements and American National Standards B11.19 and B11.20 Machine Tool Safety Standards.

***Duty Standard Cross Reference Table:***

This table identifies some of the activities that require the Safe Operating Practices KSAO.

<b>Duty Area</b>	<b>Task</b>	<b>Activity</b>
1. Job planning	Preparation of safety plan	Inspect work area and describe any corrections needed to improve safety.
2. Job execution	Building of mold	Demonstrate the ability to employ safe practices.

## **Appendix A**

### Duties and Standards

for

## **Machining Skills—Level II**

The National Institute for Metalworking Skills, Inc.

A Level II mold and diecasting diemaker is expected to possess all the skills found in *Duties and Standards for Machining Skills—Levels I and II*. The following pages describe the specific duties taken from the Level II machining skills that the technical work group considered to be the minimum requirement for a Level II moldmaker. Descriptions of the duty areas, performance standards, and accuracy levels only are given. For a complete list of requirements see *Duties and Standards for Machining Skills—Level II*.

**Duty Area:** 1. **Job Manufacturing Planning**  
**Duty Title:** 1.1 **Develop a Manufacturing Plan**

***Duty Area:***

Write a detailed manufacturing plan that includes a quality plan for a part requiring milling, drilling, turning, grinding, EDM, polishing, and quality assurance.

***Performance Standard:***

Given a part with a finished layout and access to appropriate machine tools, produce an operation sheet detailing the manufacturing plan and required speeds and feeds. Provide sketches and special instructions as needed.

***Accuracy Level:*** N/A

**Duty Area:** 2. **Job Execution**  
**Duty Title:** 2.3 **Turning Operations: Between Centers Cylindrical and Taper Turning**

***Duty Area:***

Set up and perform between centers turning for straight, cylindrical, and tapered turning by offsetting the tailstock.

***Performance Standard:***

Given raw material, manufacturing plan, print, hand, precision, and cutting tools, as well as access to an appropriate turning machine and its accessories, produce a part matching the manufacturing plan and the print specifications using appropriate trade techniques and speeds and feeds. The part specified should have at least two straight diameters within  $\pm .001$ , an appropriate taper at each end of the part, and require a reversal of the part end for end.

***Accuracy Level:***  $\pm .015$  on all fractions,  $\pm .005$  on all decimals unless otherwise specified on the print. Diameters to be concentric within  $.001$  T.I.R. Surface finish 63 microinches or better.

**Duty Area: 2. Job Execution**  
**Duty Title: 2.4 Production: Turning**

***Duty Area:***

Set up and operate a turning machine to produce a collection of parts.

***Performance Standard:***

Given a turning machine, part print, necessary tooling, and material, produce a group of parts to required specifications. The part should be similar to a shoulder bushing. The major OD should be 1, “the minor OD .750, the ID 1/2”, and the overall length should be 1-1/4”.

***Accuracy Level:*** +/- .015 on all fractions, +/- .005 on all decimals unless otherwise specified on the print; diameters to be concentric within .001 T.I.R.

**Duty Area: 2. Job Execution**  
**Duty Title: 2.5 Turning Operations: Chucking, OD and ID Tapers Using a Taper Attachment**

***Duty Area:***

Set up and perform tapered boring and turning using a taper attachment.

***Performance Standard:***

Given raw material, manufacturing plan, print, hand, precision, and cutting tools, as well as access to an appropriate turning machine with a taper attachment and its accessories, produce a part matching the manufacturing plan and print specifications using appropriate trade techniques and speeds and feeds. The part specified should have at least two diameters within +/- .002, one bore within +/- .002, one external and one internal taper, and require at least two chuckings or other work-holding setup.

***Accuracy Level:*** +/- .015 on all fractions, +/- .005 on all decimals unless otherwise specified on the print; diameters to be concentric within .003 T.I.R.

**Duty Area:** 2. Job Execution  
**Duty Title:** 2.6 Milling: Square Up a Block

***Duty:***

Set up and perform squaring up the six surfaces of a block to within +/- .002 and .002 over 4" squareness.

***Performance Standard:***

Given raw material, manufacturing plan, print, hand, precision, and cutting tools, as well as access to an appropriate milling machine and its accessories, produce a part matching the manufacturing plan and the print specifications. The part will require squaring up from the raw state.

***Accuracy Level:*** +/- .002 on all decimals unless otherwise specified on the print. Surfaces square to within .002 over 4", 63 microinch finish.

**Duty Area:** 2. Job Execution  
**Duty Title:** 2.7 Vertical Mill: Precision Location of Holes

***Duty Area:***

Set up and perform boring for location, size, and finish.

***Performance Standard:***

Produce three bores to specification. The part will specify 3 holes in 1" plate. The holes will be between 3/4 and 1-1/2 to locations within +/- .001 and hold diameters to within +/- .0005. One hole is to be counterbored to a decimal depth holding +/- .002 and a counterbore diameter of within +/- .005.

***Accuracy Level:*** +/- .015 on all fractions, +/- .005 on all decimals unless otherwise specified on the print.

**Duty Area:** 2. Job Execution  
**Duty Title:** 2.8 Milling: Use Rotary Tables

***Duty Area:***

Set up and perform the development of surfaces at a specified right angle using a rotary table. Set up and establish hole locations in various relationships to one another using a rotary table. The holes are in the same plane. Establish the profile of a radius with respect to two surfaces and the connecting points of tangency.

***Performance Standard:***

Given raw material, manufacturing plan, print, hand, precision, and cutting tools, as well as access to an appropriate milling machine, an appropriately sized rotary table, and their accessories, produce a part matching the manufacturing plan and the print specifications. The part specified will require two groups of holes arrayed on bolt circles, as well as several surfaces at various angles to one another.

***Accuracy Level:*** +/- .015 on all fractions, +/- .005 on all decimals unless otherwise specified on the print

**Duty Area:** 2. Job Execution  
**Duty Title:** 2.10 Milling: Dividing Head Operations

***Duty Area:***

Set up and perform operations requiring a dividing head. Set up and establish hole locations in various relationships to one another using a dividing head. Establish the profile of a radius with respect to two surfaces and the connecting points of tangency.

***Performance Standard:***

Given raw material, manufacturing plan, print, hand, precision, and cutting tools, as well as access to an appropriate milling machine, an appropriately sized dividing head, and their accessories, produce a part matching the manufacturing plan and the print specifications. The part specified will require two groups of holes arrayed on an outer diameter, as well as several surfaces at various angles to one another.

***Accuracy Level:*** +/- .015 on all fractions, +/- .005 on all decimals unless otherwise specified on the print.

**Duty Area: 2. Job Execution**  
**Duty Title: 2.11 Machine Tool Power Tapping: Taper Reaming and Pipe Tapping**

***Duty Area:***

Set up and perform taper reaming and subsequent pipe tapping.

***Performance Standard:***

Set up, drill, taper ream, and tap a series of holes to print specification.

***Accuracy Level:*** +/- .015 on all fractions, +/- .005 on all decimals unless otherwise specified on the print; diameter of tapped hole +/- 1/2 thread on the required pipe thread plug gage

**Duty Area: 2. Job Execution**  
**Duty Title: 2.12 Surface Grinding: Finish Flats to +/- .0005**

***Duty Area:***

Grind a block's six faces to finished dimensions having tolerances of +/- .0005 and squareness of .0005 over 4", and a 32 microinch surface finish. Dress the wheel as necessary.

***Performance Standard:***

Given a block squared up on a mill, hardened to 55 to 60 R<sub>c</sub>, a manufacturing plan, print, hand and precision tools, and choice of a grinding wheels, as well as access to a surface grinder and its accessories, dress the wheel, produce a part matching the manufacturing plan and the print specifications using appropriate trade techniques. The part specified will be in the semi-finished state having been squared up. Finishing the part will require the precision finishing of the six faces of the block to tolerances common to precision grinding for squareness, size, and surface finish characteristics.

***Accuracy Level:*** +/- .0005 on all decimals unless otherwise specified on the print; square within .0005 over 4"

**Duty Area:** 2. Job Execution

**Duty Title:** 2.13 Surface Grinding: Finish Flats at Simple Angles

***Duty Area:***

Set up and perform the finish surface grinding of flat surfaces at simple angles with respect to one another. Dress the wheel as necessary.

***Performance Standard:***

Given a block roughed out on a mill, a manufacturing plan, print, hand and precision tools, and choice of grinding wheels, as well as access to a surface grinder and its accessories, dress the wheel, grind the specified angled surfaces to a finish matching the manufacturing plan and the print specifications using appropriate trade techniques. The part specified will be in the semi-finished state having been roughed out. Finishing the part will require the precision finishing of the specified surfaces of the block to tolerances common to precision grinding for squareness, size, and surface finish characteristics.

***Accuracy Level:*** +/- .0005 on all decimals unless otherwise specified on the print;  
square within .001 over 4"; angles to be held within +/-15.

**Duty Area:** 2. Job Execution

**Duty:** 2.14 Grinding Wheel Preparation and Balancing

***Duty Area:***

Set up and perform the preparation and balancing of a grinding wheel 14" diameter or greater. Place the wheel into service.

***Performance Standard:***

Given a wheel and appropriate equipment prepare the wheel to go into service. Mount the wheel. Produce a surface finish of 32 microinches or better on a cylinder of CRS.

***Accuracy Level:*** N/A

**Duty Area:** 2. Job Execution  
**Duty Title:** 2.15 Cylindrical Grinding

***Duty Area:***

Set up and perform between centers grinding for cylindrical shapes. Dress the grinding wheel as necessary.

***Performance Standard:***

Given a part rough finished on three diameters, mount the part between centers and grind the required diameters to finish. Perform wheel dressing and balancing. Select proper wheel grit and type.

***Accuracy Level:*** +/- .015 on fractions, +/- .005 on decimals, +/- .0005 on ground diameters

**Duty Area:** 2. Job Execution  
**Duty Title:** 2.16 EDM: Operate a Conventional EDM Machine

***Duty Area:***

Operate a conventional sinker (plunge) electric discharge machine.

***Performance Standard:***

Given a print, manufacturing plan, an appropriate selection of electrodes, work-holding devices, EDM fluids, and a sinker (plunge) EDM machine, perform the EDM operation called out on the manufacturing plan.

***Accuracy Level:*** As required on print

**Duty Area:** 2. Job Execution  
**Duty Title:** 2.17 EDM: Operate a 2-Axis Wire EDM

***Duty Area:***

Operate a 2-axis wire electric discharge machine (EDM).

***Performance Standard:***

Given a print, manufacturing plan, an appropriate selection of wire electrodes, work-holding devices, EDM fluids, and a 2-axis wire EDM machine, perform the EDM operation called out on the manufacturing plan.

***Accuracy Level:*** As required on print

## Appendix B

### Technical Work Group Moldmaker and Die Casting Diemaker Skills—Level II

James Atols Atols Tool and Mold Schiller Park, IL	Chris Jones Rapid Die & Eng.Inc Grand Rapids, MI	Ralph Swain Paragon Die & Mold Grand Rapids, MI
Bruce Braker Tooling and Mfging Assoc. Park Ridge, IL	Art Kay Duraco Products Streamwood, IL	Bernie Terpenine American Mold Co. Elk Grove Village, IL
Tim Doran Tristate Machinery Co. Wheeling, IL	John Levering MINCO Tool Dayton, OH	NIMS Staff Robert W. Sherman Vienna, VA
Michael Florian Plano Molding Co. Plano, IL	William Ludlow Vincennes University Vincennes, IN	
Richard Fugman Panduit Corp. Tinley Park, IL	James Meinart Snider Mold Co. Mequon, WI	
Lon Garvey NTMA Ft. Washington, MD	William Moore Delta Tool Co. Auburn Hills, MI	
Joe Genc Actrol Tool Elk Grove Village, IL	Helmut Mueller Helm Tool Co. Elk Grove Village, IL	
Joseph Grunwald Chicago, IL	Manfred Mueller Northwestern Tool & Mold Skokie, IL	
Gerald Hobson Hobson Mold Shell Rock, IA	Don Smith Spectra Tool Industries Wheeling, IL	
Manfred Hoffmann Caco-Pacific Corp. Covina, CA	Gene Stemm Hanson Mold Co. St. Joseph, MI	

