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ABSTRACT

This document of skill standards for the machining skills cluster serves as a guide to workforce preparation program providers in defining content for their programs and to employers to establish the skills and standards necessary for job acquisition. These 67 occupational skill standards describe what people should know and be able to do in an occupational setting. Each skill standard contains at least these three areas: performance area (summary of work to be performed); skill standard with conditions of performance, work to be performed, and performance criteria; and performance elements and assessment criteria. These sections may also be included: performance area and assessment and credentialing approach. Introductory materials include the developmental process; assumptions underlying the standards; table of contents; and performance skill levels. Standards, divided into three skill levels, include: manual operations; milling; drill press and power saw operation; surface grinding; electric discharge machine; computer numerical control; turning operations; and inspection. Appendixes include a glossary; lists of committee and council members; and workplace skills. (YLB)

ILLINOIS

OCCUPATIONAL SKILL STANDARDS

MACHINING SKILLS CLUSTER

ILLINOIS OCCUPATIONAL SKILL STANDARDS
MACHINING SKILLS CLUSTER

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ILLINOIS OCCUPATIONAL SKILL STANDARDS

MACHINING SKILLS CLUSTER

Adapted from the
National Machining Skill Standards
and
Endorsed for Illinois
by the
Illinois Occupational Skill Standards and Credentialing Council

MESSAGE TO ILLINOIS CITIZENS

Dear Citizens of Illinois:

Preparing youth and adults for entry into the workforce and the ability of individuals to contribute to society throughout their lives are critical to the economy of Illinois. Public and private interest in establishing national and state systems of industry-driven skill standards and credentials is growing in the United States, especially for occupations that require less than a four-year college degree. This interest stems from the understanding that the United States will increasingly compete internationally by increasing the skills and productivity of the front-line workforce. The major purpose of skill standards and credentialing systems is to promote education and training investment and ensure that this education and training enables students and workers to meet industry standards that are benchmarked to our major international competitors.

The Illinois Occupational Skill Standards and Credentialing Council (IOSSCC) has been working with industry subcouncils, the Illinois State Board of Education and other partnering agencies to adopt, adapt and/or develop skill standards for high demand occupations. This document represents the work of the Manufacturing Subcouncil and the associated standards development committee. Through this collaborative effort, skill standards products are being developed for a myriad of industries, occupational clusters and occupations. Upon completion of these products, there will be a period of feedback and comment from business, industry and labor representatives as well as educators.

Once finalized, these documents will serve as a guide to workforce preparation program providers in defining content for their programs and to employers to establish the skills and standards necessary for job acquisition. These standards will also serve as a mechanism for communication among education, business, industry and labor.

We encourage the review of these standards and request your comments. This effort has involved a great many people from business, industry and labor. Comments regarding their usefulness in curriculum and assessment design as well as needs for inservice and technical assistance in their implementation are critical to our efforts to move forward and improve the documents. A feedback instrument is included with this document.

Questions concerning this document may be directed to:

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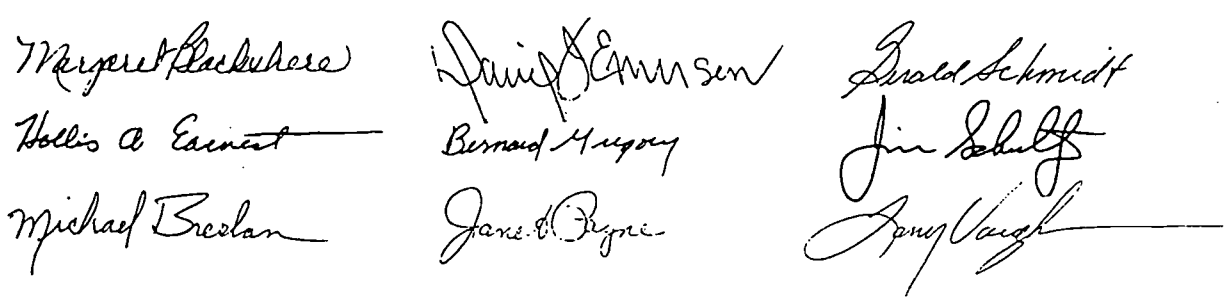
We look forward to your comments.

Sincerely,

The Members of the IOSSCC



The Illinois Occupational Skill Standards and Credentialing Council (IOSSCC) endorses occupational skill standards and credentialing systems for occupations that (a) require basic workplace skills and technical training, (b) provide a large number of jobs with either moderate or high earnings, (c) provide career advancement opportunities to related occupations with moderate or high earnings. The nine-member Council was established by The Occupational Skill Standards Act (PA 87-1210). The council, representing business, industry and labor and working with the Illinois State Board of Education in partnership with the Illinois Community College Board, Illinois Board of Higher Education, Illinois Department of Employment Security and Illinois Department of Commerce and Community Affairs, has created a common vision for workforce development in Illinois.

Vision

It is the vision of the IOSSCC to develop a statewide system of industry-defined and recognized skill standards and credentials for all major skilled occupations providing strong employment and earnings opportunities in Illinois. Information related to occupational employment and earning opportunities is determined by the Illinois Occupational Information Coordinating Committee (IOICC) in cooperation with business and industry.

Subcouncils and Standards Development Committees

The Council developed 14 industry subcouncils (representing all major industries in Illinois) to review, approve and promote occupational skill standards and credentialing systems. In cooperation with organizations such as The Illinois State Chamber of Commerce, the Illinois AFL-CIO, the Illinois Manufacturers' Association and others, the Council established the first five subcouncils in 1995—Agriculture and Natural Resources, Manufacturing, Health and Social Services, Hospitality and Business and Administrative/Information Services.

The remaining subcouncils include Applied Science and Engineering Services, Legal and Protective Services, Transportation and Distribution, Educational Services, Financial Services, Marketing and Retail Trade, Communications, Construction and Energy and Utilities.

The Standards Development Committees, composed of business, labor and education representatives, are experts in the related occupational cluster and work with the product developer to

- develop or validate occupational skill standards,
- identify related academic skills,
- develop or review assessment or credentialing approaches, and recommend endorsement of the standards and credentialing system to the industry subcouncil.

Expected Benefits for Employers, Educators, Students and Workers

Occupational skill standards and credentialing systems are being developed and promoted by the IOSSCC to improve Illinois' competitiveness. Such standards and credentialing systems provide a common language for employers, workers, students and education and training providers to communicate skill requirements and quality expectations for all major industry and occupational areas.

For Employers, skill standards will

- Improve employee recruitment and retention by more clearly identifying skill requirements.
- Encourage improved responsiveness and performance of education and training providers.
- Enlarge the pool of skilled workers.
- Focus attention on the importance of training investment.

For Education and Training Providers, skill standards will

- Provide information on all major industries and occupations.
- Contribute to program and curriculum development.
- Strengthen relationships between educators and training providers.
- Improve career planning.

For Students and Workers, skill standards will

- Enable better decision making concerning careers and the training necessary to acquire well-paying jobs.
- Allow more effective communication with employers about what they know and can do.
- Allow more effective work with employers in career development and skill upgrading.

IOSSCC Requirements for Occupational Skill Standards

Any occupational skill standards and credentialing system seeking IOSSCC endorsement must

- represent an occupation or occupational cluster which meets the criteria for IOSSCC endorsement;
- address both content and performance standards for critical work functions and activities for an occupation or occupational area;
- ensure formal validation and endorsement by a representative group of employers and workers within an industry;
- provide for review, modification and revalidation by an industry group a minimum of once every five years;
- award credentials based on assessment approaches that are supported and endorsed by the industry and consistent with nationally recognized guidelines for validity and reliability;
- provide widespread access and information to the general public in Illinois;
- include marketing and promotion by the industry in cooperation with the partner state agencies.

Definitions and Endorsement Criteria

The definitions and endorsement criteria are designed to promote the integration of existing and future industry-recognized standards, as well as the integration of the Illinois academic and occupational skill standards. Because all skill standards must address the critical work functions and activities for an occupation or industry/occupational area, the Council further defined three major components:

- ***Conditions of Performance:*** The information, tools, equipment and other resources provided to a person for a work performance.
- ***Statement of Work:*** A description of the work to be performed by a person.
- ***Performance Criteria:*** The criteria used to determine the required level of performance. These criteria could include product characteristics (e.g., accuracy levels, appearance), process or procedural requirements (e.g., safety, standard professional procedures) and time and resource requirements. The IOSSCC also requires performance criteria to be further specified by detailed individual performance elements and assessment criteria.

The IOSSCC is currently working with the Illinois State Board of Education and other state agencies to integrate the occupational standards with the Illinois academic standards which describe what students should know and be able to do as a result of their education. The Council is also working to integrate workplace skills—problem solving, critical thinking, teamwork, etc.—with both the academic and occupational skill standards.

The Illinois Model

Illinois Occupational Skill Standards describe what people should know and be able to do and how well these skills and knowledge will be demonstrated in an occupational setting. They focus on the most critical work performances for an occupation or occupational area. As seen in the following model, Illinois Occupational Skill Standards contain at least these three areas:

- Performance Skill
- Skill Standard
- Performance Elements and Assessment Criteria

The following sections may also be included at the direction of the specific standards development committee:

- Performance Area
- Assessment and Credentialing Approach

Illinois Occupational Skill Standards also carry a coding at the top of each page identifying the state, fiscal year in which standards were endorsed, subcouncil abbreviation, cluster abbreviation and standard number. For example, the tenth skill standard in the Machining Skills Cluster, which has been developed by the Manufacturing Subcouncil, would carry the following coding: IL.96.MFG.MACH.25.

A model for Illinois Occupational Skill Standards showing the placement of the coding and providing a description of each area within a standard is contained on the following page.

SUMMARY OF WORK TO BE PERFORMED. SUMMARY IS BRIEF AND BEGINS WITH AN ACTION VERB.

IL. FY. SUBCOUNCIL. CLUSTER. STANDARD NO.

Performance Area

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Includes all information, tools, equipment and other resources provided to the learner for performing the work.

WORK TO BE PERFORMED

Provides an overview of the performance with the major elements or steps being described under Performance Elements and Assessment Criteria.

PERFORMANCE CRITERIA

Includes product characteristics (e.g., accuracy levels, appearance) and/or process or procedure requirements (e.g., safety requirements). Time limits are specified whenever possible.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

Statement of the major elements, components or steps of the overall performance and the assessment criteria for determining successful performance. Includes all major tasks, the knowledge to be demonstrated

ASSESSMENT AND CREDENTIALING APPROACH

Optional statement of suggested assessment approaches for the performance

DEVELOPMENTAL PROCESS

The Manufacturing Subcouncil identified machining skills as a major occupational cluster in manufacturing. Machining skills involve the use of cutting tools to shape metal materials in single-part and serial manufacturing by means of milling, turning, grinding, boring and sawing with a variety of conventional and computer numerical control (CNC) machines and associated tooling.

The National Institute for Metalworking Skills (NIMS) has developed national standards for three levels of machining skills. NIMS is composed of a board representing metalworking related companies, trade associations and labor unions. The National Institute for Metalworking Skills developed the national machining skill standards through a nationwide validation process that included regional technical work groups and national surveys.

In Illinois, the national machining skill standards were reformatted to meet requirements of the Illinois Occupational Skill Standards and Credentialing Council (IOSSCC). The Manufacturing Subcouncil established a standards development committee to review and approve the reformatted national machining standards. A copy of the reformatted standards and a survey instrument were sent to the standards development committee members. The survey returns recommended endorsement of the national machining standards and approved the reformatting. The Manufacturing Subcouncil and IOSSCC then voted to endorse the national standards as reformatted.

The IOSSCC-recognized standards will be referred to as the "Illinois Machining Skill Standards adapted from the National Machining Skill Standards to meet the format requirements of the Illinois Occupational Skill Standards and Credentialing Council."

ASSUMPTIONS FOR MACHINING SKILLS CLUSTER

Skill standards statements assume:

1. Workplace skills (employability skills) are expected of all learners. Socialization skills needed for work are related to lifelong career experience and are not solely a part of the initial schooling process. These are not included with this set of statements.
2. Specific policies and procedures of the worksite will be made known to the learner and will be followed.
3. Time elements outlined for the skill standards result from the experience and consideration of the panel of experts who made up the standards development committee.
4. Skills will progress from simple to complex. Once a skill has been successfully performed, it will be incorporated into more complex skills.
5. Skill standards describe the skill only and do not detail the background knowledge or theory related to the particular skill base. Although the skill standard enumerates steps to successful demonstration, rote approaches to the outcomes are not prescribed.
6. The Machining Skills Cluster includes three levels of standards. Local training providers should review all levels and work cooperatively to identify the level(s) of training each site can provide.
7. The English system of measurement was used in the metalworking skill standards unless otherwise indicated.
8. The time it takes to complete some standards will vary depending on the complexity of the piece being manufactured. Contact the National Institute for Metalworking Skills at 703/281-1610 for current information regarding drawings, equipment list and assessment procedures.

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SKILL LEVEL II

SKILL LEVEL II (Continued)

SKILL LEVEL III

DEVELOP A PROCESS PLAN FOR A PART REQUIRING MILLING, DRILLING, TURNING OR GRINDING. FILL OUT AN OPERATION SHEET DETAILING THE PROCESS PLAN AND REQUIRED SPEEDS AND FEEDS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprint detailing a part requiring milling, drilling, turning or grinding
Sketches, notes
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Machinery's Handbook

WORK TO BE PERFORMED

Formulate a set of strategies to manufacture a part and fill out an operation sheet reflecting the chosen strategies including the required speeds and feeds.

PERFORMANCE CRITERIA

The finished job process plan matches the elements of the model plan or alternate relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The process plan matches the model process plan, or an alternative process plan matches standard practices for such a job in the estimation of two designated examiners.
- The applicant answers questions regarding the process plan, the tooling techniques and the equipment it involves.
- Appropriate trade techniques are used to produce the process plan.
- All relevant paperwork is completed and is in order.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

TAP HOLES. USE FILES, SCRAPERS AND COATED ABRASIVES TO DEBURR PARTS. USE ARBOR PRESSES TO PERFORM PRESS FITS. USE BENCH VISES AND HAND TOOLS APPROPRIATELY.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Part requiring the operations listed above
Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Components required to complete the assembly
Machinery's Handbook

WORK TO BE PERFORMED

Deburr a part, tap holes, press in a bushing, install a stud and saw the stud to a specified length.

PERFORMANCE CRITERIA

Appropriate trade techniques are used to produce an assembly meeting the following characteristics: no sharp edges or burrs, acceptable threads, accurate stud length, sawed face square to axis of stud and assembled bushing. At completion the assembly meets the blueprint requirements. All relevant paperwork is completed and is in order. The work area is returned to a neat and clean state. Safe practices are used throughout the performance.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is free of sharp edges or burrs.
- The part satisfies the Go/NoGo gage for the threads.
- Length of stud is within 1/32 of basic dimension and square to surface.
- The bushing is assembled using correct techniques and at completion meets the blueprint requirements.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

LAY OUT THE LOCATION OF HOLE CENTERS AND SURFACES WITHIN AN ACCURACY OF +/-.015".

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions for the task at hand
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Part matching the layout blueprint, material: 1018 Hot Rolled Steel (HRS)
- Layout surface plate at least 12" x 18"
- Surface gage
- Prick punch
- Ball-peen hammer
- Common workbench
- Layout height gage
- Combination set
- Scriber
- Layout ink
- Angle plate
- C-clamps
- Parallel-closing clamps
- Magnifying glass
- Radius gages
- 6" dividers
- Machinery's Handbook

WORK TO BE PERFORMED

Lay out hole locations, radii and surfaces matching the specifications.

PERFORMANCE CRITERIA

The layout matches the specifications, paperwork is complete and housekeeping performed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The layout conforms to the requirements of the blueprint and process plan.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.

SET UP AND PERFORM BETWEEN CENTERS TURNING OPERATIONS FOR STRAIGHT TURNING.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- Engine lathe of 14" x 30" minimum capacity (The lathe may have a quick-change gear box with the threads called for on the blueprint available from the gear box.)
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- Tool post
- Right- and left-hand turning tools capable of turning a square shoulder
- External threading tool matched to print requirements
- Drill chuck
- Combination drill and countersink
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Turn a part to specification by mounting the part between centers. The part specified should have at least three diameters within +/-.002", one Unified National Coarse (UNC) external thread and one Unified National Fine (UNF) external thread and should require an end-for-end swap.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- Engine lathe of 14" x 30" minimum capacity (The lathe may have a quick-change gear box with the threads called for on the blueprint available from the gear box.)
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- Tool post
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to print requirements
- Drill chuck
- Combination drill and countersink
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Turn a part matching the process plan and the blueprint specifications using chucking methods and techniques. The part specified should have at least three diameters within +/-.005", one bore within +/-.005", one Unified National Coarse (UNC) external and one Unified National Fine (UNF) internal thread and should require at least two chuckings or other workholding setup.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND OPERATE A HORIZONTAL OR VERTICAL MILLING MACHINE USING POWER FEEDS. PERFORM ROUTINE MILLING.

POWER FEED MILLING

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Mill with power feed on the X and Y axes, table capacity of approximately 12" x 36", 40-taper spindle or greater preferred
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps sufficient to secure the vise or the part to the table
- Assorted parallels
- Ball-peen and soft-faced hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- 2" or larger diameter cutter that may be a face mill
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Edge finder
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Mill a part matching the process plan and the blueprint specifications. The part specified should require squaring up from the unfinished state and require significant material removal. Depth of cuts between .200" and .250" will be required. Calculate, set and use the power feed controls to remove material and establish finishes.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND OPERATE VERTICAL MILLING MACHINES. PERFORM ROUTINE MILLING AND LOCATION OF HOLE CENTERS WITHIN +/-.005".

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Vertical mill, table capacity of approximately 12" x 36"
- Material matching the vertical milling blueprint, material: 1018 Hot Rolled Steel (HRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps to secure the vise or part to the table
- Assorted parallels
- Ball-peen and soft-faced hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Drill chuck
- Drills
- Reamers
- Combination drill and countersink or spotting drill
- Countersink and edge finder
- Coolants and cutting oil
- 0-6 micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Depth micrometer
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Mill a part to specification using appropriate trade techniques and speeds and feeds. The part specified should require squaring up from the raw state, have at least one milled slot, require the location of at least two drilled and reamed holes within +/- .005" and have three steps controlled by tolerances of +/-.005".

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

RING TEST GRINDING WHEELS, PERFORM VISUAL SAFETY INSPECTION AND MOUNT AND DRESS A GRINDING WHEEL IN PREPARATION FOR SURFACE GRINDING.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
MACHine tool and accessory inventory
Common workbench with a precision surface plate
Surface grinder
Magnetic chuck
Assorted grinding wheels suitable for mounting to the spindle
Soft-faced hammer
Assorted wrenches
Screwdrivers
Specialty hand tools for the spindle
Diamond dresser
Machinery's Handbook

WORK TO BE PERFORMED

Determine which grinding wheels among a group of grinding wheels are suitable for use, mount one on the spindle and dress it in preparation for surface grinding.

PERFORMANCE CRITERIA

The collection of wheels has been separated into acceptable and not acceptable categories. Not acceptable wheels are labeled and secured from use. An acceptable wheel is mounted using safe and appropriate practices, and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The collection of grinding wheels is evaluated correctly.
- The failed grinding wheels are labeled and appropriately secured from future use.
- Appropriate trade techniques are used to evaluate the wheels and mount the sound wheel.

- **All relevant paperwork is completed and is in order.**
- **The work area is returned to a neat and clean state.**
- **The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/201-1610.**
- **Safe practices are used throughout the performance.**

SET UP AND OPERATE MANUAL SURFACE GRINDERS WITH A 10" AND SMALLER DIAMETER WHEEL. PERFORM ROUTINE SURFACE GRINDING, LOCATION OF SURFACES AND SQUARING OF SURFACES. PERFORM WHEEL DRESSING.

SURFACE GRINDING: HORIZONTAL SPINDLE, RECIPROCATING TABLE

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench with a precision surface plate
- Surface grinder with a suitable magnetic chuck
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- Magnetic chuck
- Assorted parallels
- Suitable angle plate or precision grinding vise
- Assorted clamps
- Composition hammer
- Assorted grinding wheels suitable for mounting to the spindle
- Files
- Magnetic base for indicators
- Surface gage of sufficient size
- Diamond dresser
- Required micrometers
- Combination set
- Dial test indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Depth micrometer set
- Master square or magnetic square
- Surface finish comparison gages
- Machinery's Handbook

WORK TO BE PERFORMED

Dress the wheel; produce a part matching the process plan and the blueprint 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.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- The collection of grinding wheels is evaluated correctly.
- The failed grinding wheels are labeled and appropriately secured from future use.
- Appropriate trade techniques are used to evaluate the wheels and mount sound wheels.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND OPERATE DRILL PRESSES. PERFORM ROUTINE DRILL PRESS OPERATIONS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Drill press, Morse taper #3 spindle capacity or greater preferred (The drill press must have a tapping capability or a tapping head accessory.)
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- Cutting fluids
- 6" drill vise or greater
- Screws, studs, nuts, washers and clamps sufficient to secure the vise or part
- Assorted parallels
- Composition hammer
- Assorted Morse taper sleeves fitted to the machine spindle
- Drill chucks
- Drills
- Reamers
- Countersinks
- Spot facers
- Counterbores
- Centerdrills
- Various taps
- Scriber
- Layout ink
- Prick punch
- Ball-peen hammer
- Angle plate
- 6" dividers
- Surface gage
- Required micrometers
- Combination set
- 6" rule
- 6" vernier, dial or electronic caliper
- Go/NoGo gage for threads
- Plug gages
- Telescoping gages
- Layout height gage
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part matching the process plan and the blueprint specifications. The part specified will be in the semi-finished state having been squared up and the outer surfaces completed with four center-drilled locations. Finishing the part will require the finishing of the four center-drilled locations and the layout of a fifth location. Each hole must have at least two secondary operations. The secondary operations will consist of reaming, spot facing, countersinking, counterboring and counterdrilling. At least one hole must be a blind hole and one a through hole. The fifth hole, a through hole, must have its location center punched, center-drilled and finished from the layout. The fifth hole will be power tapped.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND OPERATE POWER SAWS FOR CUTOFF OPERATIONS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Power saw with a suitable blade installed
Part matching the blueprint requirements for material, material: 1018 Hot Rolled Steel (HRS)
Soft-faced hammer
Appropriate wrenches
Tape measure or appropriate rule
Files
Machinery's Handbook

WORK TO BE PERFORMED

Saw material to a length matching the cut listed on the process plan.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

DEVELOP AN INSPECTION PLAN AND INSPECT SIMPLE PARTS USING PRECISION TOOLS AND TECHNIQUES. PREPARE REPORTS ON THE COMPLIANCE OF THE PARTS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Common workbench with a small surface plate
Finished part matching the requirements of the part inspection blueprint
Inspection-grade gage blocks, angle plates and clamps
Appropriate assortment of basic, fixed, precision and surface plate inspection tools
Machinery's Handbook

WORK TO BE PERFORMED

Identify and select the required measuring instruments, and conduct the required inspection procedure(s). Complete required written inspection report, and make a decision to accept or reject component parts. Provide brief verbal explanation of inspection procedures, results and decisions.

PERFORMANCE CRITERIA

The inspection report satisfies the elements of the model report, appropriate techniques were used to gather the data for the report, paperwork is complete, housekeeping is accomplished and safe practices are used.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The inspection report findings match the findings of the model inspection report.
- Appropriate trade techniques are used to produce the inspection findings.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

FOLLOW A SAMPLING PLAN. INSPECT THE SAMPLES FOR THE REQUIRED DATA. ENTER THE DATA ON APPROPRIATE CHARTS. GRAPH THE DATA. RESPOND TO THE WARNING CONDITIONS INDICATED BY THE PROCESS CHARTS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Common workbench with a small surface plate
X-bar and R charts
Inspection tools sufficient to perform the sampling and inspection plan
Appropriate population of product matching the blueprint specifications and broken up into discrete packages matching the requirements of the sampling plan
Machinery's Handbook

WORK TO BE PERFORMED

Inspect parts according to the sampling plan, collecting the data required for the process control chart. Working within the supplied control and warning limits, place the data, produce new data as needed, graph the data and take the Stop or Go actions as indicated by the results of producing the process control chart. Provide brief verbal explanation regarding the decision taken.

PERFORMANCE CRITERIA

The inspection report satisfies the elements of the model report, appropriate techniques were used to gather the data for the report, paperwork is complete, housekeeping is accomplished and safe practices are used.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The inspection report findings match the findings of the model process reports.
- The candidate can successfully answer relevant questions regarding the reports.
- Appropriate trade techniques are used to produce the inspection findings.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

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ANALYZE THE PERFORMANCE OF A SINGLE-PART PRODUCTION PROCESS. FORMULATE PROCESS ADJUSTMENTS OR IMPROVEMENTS WHERE APPROPRIATE. WHERE APPROPRIATE, NOTIFY SUPERVISION OF THE PROPOSED ADJUSTMENT AND/OR IMPROVEMENT. WHERE AUTHORIZED, PERFORM THE STRATEGIES FOR PROCESS ADJUSTMENT AND/OR IMPROVEMENT.

PROCESS ADJUSTMENT IN SINGLE-PART PRODUCTION

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Common workbench
Machine tool with a setup in use
Part matching the setup, material: 1018 Hot Rolled Steel (HRS)
Cutting fluids
Tooling necessary to the setup
Inspection tools appropriate to the problem presented
Machinery's Handbook

WORK TO BE PERFORMED

Analyze a part having routine problems being processed, analyze the problems and propose remedies. Having been given authorization to implement the process improvement, carry it out. Explain the corrective actions and the reasoning used to perform the diagnosis.

PERFORMANCE CRITERIA

The findings match the elements of the model report; relevant questions are answered; appropriate trade techniques are used to generate the findings. Paperwork is completed, safe practices are used and housekeeping is performed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- **The reported findings match the findings of the model problem reports.**
- **The applicant answers successfully all relevant questions regarding the reports.**
- **Appropriate trade techniques are used to produce the findings.**
- **All relevant paperwork is completed and is in order.**
- **The work area is returned to a neat and clean state.**
- **The time will vary with the complexity of the operation.**
- **Safe practices are used throughout the performance.**

ANALYZE THE PERFORMANCE OF A PRODUCTION PROCESS AS A MEMBER OF A PROCESS TEAM. WITH THE TEAM, FORMULATE PROCESS ADJUSTMENTS OR IMPROVEMENTS WHERE APPROPRIATE. WHERE APPROPRIATE, NOTIFY SUPERVISION OF THE PROPOSED ADJUSTMENTS AND/OR IMPROVEMENT. WHERE AUTHORIZED, PERFORM THE STRATEGIES FOR PROCESS ADJUSTMENT AND/OR IMPROVEMENT.

PROCESS IMPROVEMENT PARTICIPATION

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Team conference area
Fishbone charts
Flip charts
Markerboard
Writing tools
Markers
Relevant measuring instruments for the problem posed
Machinery's Handbook

WORK TO BE PERFORMED

As a team member, analyze a routine production process having a problem. As a team member, analyze the problem and propose a remedy. Having been given authorization to implement the process improvement, perform it. Perform the cause and effect analysis by participating in the development of a fishbone diagram with the team. Explain the fishbone diagram, the corrective actions and the reasoning connecting the fishbone root cause analysis to the remedial actions taken.

PERFORMANCE CRITERIA

The team activities are explained; relevant questions are answered; appropriate trade techniques are applied. Paperwork is completed, housekeeping is performed and safe practices are used.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The team's activities in producing problem resolution reports are successfully explained.
- The applicant answers successfully all relevant questions regarding the reports.
- Appropriate trade techniques are used to produce the findings.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

KEEP THE DUTY STATION CLEAN AND SAFE FOR WORK. KEEP THE TOOLS, WORKBENCHES AND MANUAL EQUIPMENT CLEAN, MAINTAINED AND SAFE FOR WORK.

GENERAL HOUSEKEEPING AND MAINTENANCE

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Maintenance, cleaning and housekeeping checklists
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Common workbench
Machine tool work area
Brooms
Brushes
Vacuum cleaner
Waste containers
Occupational Safety and Health Administration (OSHA) guidelines

WORK TO BE PERFORMED

Clean, maintain and respond appropriately to safety hazards on all benchwork tools and conventional and Computer Numerical Control (CNC) machine tools. Maintain the cleanliness of the general work area.

PERFORMANCE CRITERIA

Housekeeping activities match the checklist, questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- Each element of the checklists is performed successfully.
- All relevant questions are answered regarding the maintenance activity.
- Appropriate trade techniques are used to accomplish the work.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

PERFORM ROUTINE PREVENTIVE MAINTENANCE INCLUDING COMMON ADJUSTMENTS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Standard machine tool
Maintenance forms
Oil
Grease
Shop towels
Hand tools for minor adjustments of guards and tooling
6" rule
Machinery's Handbook

WORK TO BE PERFORMED

Inspect and assess the general condition of an assigned machine tool. Make routine adjustments as necessary and as authorized. Perform daily, weekly and/ or monthly routine upkeep chores cited on checklists for a given machine tool. Report problems which are beyond the scope of authority. Fill out the history forms for tracking maintenance.

PERFORMANCE CRITERIA

Maintenance activities match the checklist, relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- Each element of the checklists is performed successfully.
- All relevant questions are answered successfully regarding the maintenance activity.
- Appropriate trade techniques are used to accomplish the work.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

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INSPECT AND ASSESS THE CONDITION OF TOOLING. REFURBISH TOOLING WHERE APPROPRIATE. REFER TOOLING FOR REPAIR OR REGRIND WHERE APPROPRIATE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Samples of tooling in various conditions
- Common workbench
- Pedestal grinder
- Drills
- Milling cutter bodies with inserts
- Wrenches for cutter bodies
- Turning tool blanks
- Required micrometers
- Combination set
- 6" rule
- 6" vernier, dial or electronic caliper
- Plug gages
- Telescoping gages
- Layout height gage
- Dial indicator and base
- Surface plate
- Machinery's Handbook

WORK TO BE PERFORMED

Diagnose tooling; perform the procedures to put the tooling back in service. The sample tooling will include turning, milling and drilling tools. These tools will be both insert tooling as well as conventional tooling. The technician must demonstrate the offhand grinding of a drill between the diameter of .125" and 1.000". The offhand regrinding of a turning tool and the correct rotation and replacement of inserts in an insert style milling cutter body must be demonstrated. The technician must demonstrate the ability to recognize when a cutter should be referred to a tool and cutter grinder.

PERFORMANCE CRITERIA

The elements of the tooling checklist are satisfied, tooling is evaluated and treated appropriately, relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- Each element of the checklists is performed successfully.
- The tooling is evaluated and treated correctly.
- All relevant questions are answered successfully regarding the maintenance activity.
- Appropriate trade techniques are used to accomplish the work.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

PERFORM ASSIGNED MACHINE OPERATION AND MATERIAL HANDLING RESPONSIBILITIES WHILE ADHERING TO SAFE PRACTICES IN ACCORDANCE WITH OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) REQUIREMENTS AND GUIDELINES. DOCUMENT SAFETY ACTIVITIES AS REQUIRED.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Appropriate materials and containers
Appropriate handling devices
Occupational Safety and Health Administration (OSHA) Guidelines

WORK TO BE PERFORMED

Demonstrate safe workplace practices in material handling; machine operations; handling of tooling and handling and application of coolants, cutting fluids and lubricants. Orally explain the actions taken which directly or indirectly bear upon safe practice in the execution of Level I Machining Skill Standards 2 - 11.

PERFORMANCE CRITERIA

The elements of the checklist are satisfied, relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- Each element of the checklists is performed successfully.
- All relevant questions are answered successfully regarding the maintenance activity.
- Appropriate trade techniques are used to accomplish the work.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

HANDLE AND STORE HAZARDOUS MATERIALS AS ASSIGNED WHILE ADHERING TO SAFE PRACTICES IN ACCORDANCE WITH OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA) AND ENVIRONMENTAL PROTECTION AGENCY (EPA) REQUIREMENTS AND GUIDELINES. DOCUMENT SAFETY ACTIVITIES AS REQUIRED.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Hazardous material and appropriate containers
Appropriate handling devices
Appropriate material identification instruments
Instruments for the measurement of concentration
Machinery's Handbook
Relevant Environmental Protection Agency (EPA) and Occupational Safety and Health Administration (OSHA) requirements and guidelines

WORK TO BE PERFORMED

Demonstrate safe workplace practices in the identification, handling and storage of hazardous materials in the performance of all responsibilities.

PERFORMANCE CRITERIA

The elements of the checklist are satisfied, relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- Each element of the checklists is performed successfully.
- All relevant questions are answered successfully regarding the performance activity.
- Appropriate trade techniques are used to accomplish the work.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

WRITE A DETAILED PROCESS PLAN WHICH INCLUDES A QUALITY PLAN FOR A PART REQUIRING MILLING, DRILLING, TURNING OR GRINDING. PRODUCE AN OPERATION SHEET DETAILING THE PROCESS PLAN AND REQUIRED SPEEDS AND FEEDS. PROVIDE SKETCHES AS NEEDED.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprint detailing a part requiring milling, drilling, turning or grinding
Sketches, notes
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Machinery's Handbook

WORK TO BE PERFORMED

Formulate a set of strategies to manufacture a part and write a detailed process plan including a quality plan for that part. Provide sketches as needed.

PERFORMANCE CRITERIA

The finished process plan matches the elements of the model process plan or the alternate, relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The process plan matches the model process plan, or an alternative plan matches standard practices for such a job in the estimation of two designated examiners.
- All relevant questions are successfully answered regarding the process plan, tooling and equipment it involves. Appropriate trade techniques are used to produce the process plan.
- All relevant paperwork is completed and is in order.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

SET UP AND LAY OUT BOLT CIRCLES, LOCATIONS OF SURFACES RELATED BY NON-RIGHT ANGLES, LOCATIONS OF POINTS OF TANGENCY BETWEEN ARCS AND LINES AND PROFILES OF A LINE WHICH IS NON-ARC BASED.

LAYOUT OF BOLT CIRCLES, ANGLES, POINTS OF TANGENCY AND PROFILES OF A LINE

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Part requiring the operations listed above
- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions for basic, routine benchwork, machining and mechanical assembly operations
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Part matching the layout blueprint, material: 1018 Hot Rolled Steel (HRS)
- Layout surface plate at least 12" x 18"
- Surface gage
- Layout height gage
- Combination set
- Scriber
- Layout ink
- Prick punch
- Ball-peen hammer
- Common workbench
- Angle plate
- C-clamps
- Parallel-closing clamps
- Magnifying glass
- Radius gages
- 6" dividers
- Machinery's Handbook

WORK TO BE PERFORMED

Lay out a block of material which includes a flange face feature with a 12-hole bolt circle, two examples of tangent radii—one a fillet, the other an external radius—and a defined profile of a line with approximating arcs and their coordinates supplied.

PERFORMANCE CRITERIA

The layout matches the specifications, paperwork is complete and housekeeping is performed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The layout conforms to the requirements of the blueprint and process plan.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.

SET UP AND PERFORM CONTOUR SAWING TO A LAYOUT. CHOOSE AND MOUNT APPROPRIATE BLADES. WELD, BREAK AND REWELD BLADES AS NECESSARY.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions for the task at hand
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Part matching the material requirements of the print, material: 1018 Hot Rolled Steel (HRS)
- Bandsaw adequate to the task
- Layout surface plate at least 12" x 18"
- Surface gage
- Layout height gage
- Combination set
- Scriber
- Layout ink
- Prick punch
- Ball-peen hammer
- Common workbench
- Angle plate
- C-clamps
- Parallel-closing clamps
- Magnifying glass
- Radius gages
- 6" dividers
- Machinery's Handbook

WORK TO BE PERFORMED

Use a contour bandsaw to produce a part to specification.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM BETWEEN CENTERS TURNING FOR STRAIGHT AND TAPERED TURNING BY OFFSETTING THE TAILSTOCK.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- Engine lathe of 14" x 30" minimum capacity (The lathe may have a quick-change gear box with the threads called for on the blueprint available from the gear box.)
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- Tool post
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to print requirements
- Drill chuck
- Combination drill and countersink
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Micrometers
- Combination set
- Thread-pitch gages
- Center gages
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliber
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part requiring taper turning. The part specified should have at least two straight diameters within +/-.001" and an appropriate taper at each end of the part and require a reversal of the part end for end.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND OPERATE A TURNING MACHINE TO PRODUCE A COLLECTION OF PARTS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- Engine lathe of 14" x 30" minimum capacity (The lathe may have a quick-change gear box with the threads called for on the blueprint available from the gear box.)
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- Tool post
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to print requirements
- Drill chuck
- Combination drill and countersink
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a group of parts to specification. The part should be similar to a shoulder bushing. The major Outside Diameter (OD) should be 1", the minor Outside Diameter (OD) .750", the Inside Diameter (ID) 1/2" and the overall length should be 1-1/4". The lot size should be 15.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM TAPERED BORING AND TURNING USING A TAPER ATTACHMENT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- Engine lathe of 14" x 30" minimum capacity and having a taper attachment (The lathe may have a quick-change gear box with the threads called for on the blueprint available from the gear box.)
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Material matching the requirements of the blueprint, material: 1018 Hot Rolled Steel (HRS)
- Tool post
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to print requirements
- Drill chuck
- Combination drill and countersink
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6"vernier, dial or electronic caliper
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part to specification. The part specified should have at least two diameters within +/-.002", one bore within +/-.002" and one external and one internal taper and require at least two chuckings or other workholding setup.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM SQUARING UP THE SIX SURFACES OF A BLOCK TO WITHIN +/-.002" AND .002" OVER 4" SQUARENESS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Mill, table capacity of approximately 12" x 36"
- Material matching the milling blueprint, material: 1018 Hot Rolled Steel (HRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps to secure the vise or part to the table
- Assorted parallels
- Ball-peen and soft-faced hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Drill chuck
- Drills
- Reamers
- Combination drill and countersink or spotting drill
- Countersink and edge finder
- Coolants and cutting oil
- 0-6 micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Depth micrometer
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Square up a block using a milling machine. The part will require squaring up from the raw state.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM BORING FOR LOCATION, SIZE AND FINISH.

VERTICAL MILL: PRECISION LOCATION OF HOLES

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Mill, table capacity of approximately 12" x 36"
- Material matching the milling blueprint, material: 1018 Hot Rolled Steel (HRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps to secure the vise or part to the table
- Assorted parallels
- Ball-peen and soft-faced hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Drill chuck
- Drills
- Reamers
- Combination drill and countersink or spotting drill
- Countersink and edge finder
- Coolants and cutting oil
- 0-6 micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Depth micrometer
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

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 within +/- .0005". One hole is to be counterbored to a decimal depth holding +/-.002" and counterbore diameter within +/- .005".

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM MILLING KEYSEATS ON A SHAFT.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Vertical mill, table capacity of approximately 12" x 36"
- Material matching the milling blueprint, material: 1018 Hot Rolled Steel (HRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps to secure the vise or part to the table
- Assorted parallels
- Ball-peen and soft-faced hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Edge finder
- Coolants and cutting oil
- 0-6 micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Dept micrometer
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Mill two keyseats whose characteristics match the American Standards National Institute (ANSI) B17.1 Keys and Keyseat standards.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

ILLINOIS MACHINING SKILL STANDARD, TECHNICAL ELEMENTS, SKILL LEVEL II
Adapted from the National Machining Skill Standards to meet the format requirements of the Illinois Occupational Skill Standards and Credentialing Council.

SET UP AND PERFORM THE CUTTING OF A DEEP SLOT USING A STAGGER-TOOTH CUTTER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Mill with power feed on the X and Y axes, table capacity of approximately 12" x 36", 40-taper spindle or greater preferred
- Material matching the requirements of the milling blueprint, material: 1215 Cold Rolled Steel (CRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps to secure the vise or part to the table
- Assorted parallels
- Ball-peen and composition hammers
- Assorted cutters
- Cutter adapters and arbors fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Coolants and cutting fluids
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Edge finder
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Mill three deep slots, two parallel to one another, the third at right angles to the first two.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

MILLING: USING A ROTARY TABLE

SET UP AND PERFORM THE DEVELOPMENT OF SURFACES AT A SPECIFIED NON-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.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Vertical mill, table capacity of approximately 12" x 36"
- Material matching the milling blueprint, material: 1018 Hot Rolled Steel (HRS)
- Rotary table sufficient to handle the part
- Milling vise sufficient for the part
- Screws, studs, nuts, washers and clamps to secure the vise or part
- Assorted parallels
- Ball-peen and soft-faced hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Edge finder
- Coolants and cutting oil
- 0-6 micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Depth micrometer
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part requiring two groups of holes arrayed on bolt circles as well as several surfaces at various angles to one another.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- **The part is produced to specification.**
- **Appropriate trade techniques and speeds and feeds are used to produce the part.**
- **All relevant paperwork is completed and is in order.**
- **The work area is returned to a neat and clean state.**
- **The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.**
- **Safe practices are used throughout the performance.**

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.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- Vertical mill, table capacity of approximately 12" x 36"
- Material matching the milling blueprint, material: 1018 Hot Rolled Steel (HRS)
- Dividing head sufficient to handle the part
- Milling vise sufficient for the part
- Screws, studs, nuts, washers and clamps to secure the vise or part
- Assorted parallels
- Ball-peen and soft-faced hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Edge finder
- Coolants and cutting oil
- 0-6 micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Depth micrometer
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Using a dividing head, mill a part requiring two groups of holes arrayed on an outer diameter, several surfaces at various angles to one another and the profile of a radius with respect to two surfaces and the connecting points of tangency.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM BORING FOR LOCATION, SIZE AND FINISH AND MILL A SLOT FOR LOCATION AND SIZE.

BASIC HORIZONTAL BORING MILL OPERATIONS

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench with a small surface plate
- Horizontal boring mill
- Material requirements of the boring mill blueprint, material: 1215 Cold Rolled Steel (CRS)
- Cutting fluids
- 6" drill vises or greater
- Screws, studs, nuts, washers and clamps sufficient to secure the vises, suitable angle plates or the part
- Assorted parallels
- Composition hammer
- Assorted Morse taper sleeves fitted to the machine spindle
- Drill chucks
- Edge finders
- Drills
- Centerdrills and the necessary boring bars and associated cutters
- Scriber
- Layout ink
- Prick punch
- Ball-peen hammer
- Angle plate
- 6" dividers
- Surface gage
- Required micrometers
- Combination set
- 6" rule
- 6" vernier, dial or electronic caliper
- Dial indicators
- Plug gages
- Telescoping gages
- Layout height gage
- Machinery's Handbook

WORK TO BE PERFORMED

Produce three bores, one with a decimal counterbore and one slot to specification.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Radial drill press with capacity adequate to control and drive drills of the diameter specified on the print (The drill press must have a tapping cycle or a reversible clutched spindle.)
- Material matching the requirements of the print, material: 1215 Cold Rolled Steel (CRS)
- Cutting fluids
- 6" drill vise or greater
- Screws, studs, nuts, washers and clamps sufficient to secure the vise or the part
- Assorted parallels
- Composition hammer
- Assorted Morse taper sleeves fitted to the machine spindle

Drills

- Drill chucks
- Reamers
- Countersinks
- Centerdrills and the necessary taps
- Scriber
- Layout ink
- Prick punch
- Ball-peen hammer
- Tap wrenches

Angle plate

- 6" dividers
- Surface gage
- Required micrometers
- Combination set
- 6" rule
- 6" vernier, dial or electronic caliper
- Go/NoGo gage for threads
- Plug gages
- Telescoping gages
- Machinery's Handbook

WORK TO BE PERFORMED

Set up, centerdrill, drill, countersink and tap a series of holes to specification. Perform other operations as required by the blueprint.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM TAPER REAMING AND SUBSEQUENT PIPE TAPPING.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Drill press with capacity adequate to control and drive a 1-11½" National Pipe Thread (NPT) (The drill press must have a tapping cycle, a tapping head accessory or a reversible clutched spindle.)
- Part matching the material requirements of the drill press blueprint, material: 1215 Cold Rolled Steel (CRS)
- Cutting fluids
- 6" drill vise or greater
- Screws, studs, nuts, washers and clamps sufficient to secure the vise or the part
- Assorted parallels
- Composition hammer
- Assorted Morse taper sleeves fitted to the machine spindle
- Drill chucks
- Drills
- Reamers
- Countersinks
- Centerdrills
- Necessary pipe taps
- Scriber
- Layout ink
- Prick punch
- Ball-peen hammer
- Tap wrenches
- Angle plate
- 6" dividers
- Surface gage
- Required micrometers
- Combination set
- 6" rule
- 6" vernier, dial or electronic caliper
- Go/NoGo gage for threads
- Plug gages
- Telescoping gages
- Layout height gage
- Machinery's Handbook

WORK TO BE PERFORMED

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

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

GRIND A BLOCK'S SIX FACES TO FINISHED DIMENSIONS HAVING TOLERANCES OF +/-.0005" AND SQUARENESS OF .0005" OVER 4" AND 32 MICROINCH SURFACE FINISH. DRESS THE WHEEL AS NECESSARY.

SURFACE GRINDING: FINISHING FLATS TO +/-.0005"

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Surface grinder with a suitable magnetic chuck
- Assorted grinding wheels suitable for mounting to the spindle
- Block squared up on a mill, hardened to 55 to 60 Rockwell c-scale (R_c), material: A2 Tool Steel
- Standard workbench with a precision surface place
- Suitable environmental controls
- Magnetic chuck
- Assorted parallels
- Angle plate or precision grinding vise
- Assorted clamps
- Composition hammer
- Files
- Magnetic base for indicators
- Surface gage of sufficient size
- Diamon dresser
- Required micrometers
- Combination set
- Gage lock set
- Dial test indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Comparator stand for indicators
- Depth micrometer set
- Master square or magnetic square
- Surface condition comparison gages
- Machinery's Handbook

WORK TO BE PERFORMED

Dress the wheel. Grind a part to finish. The part will require the precision finishing of six faces of a block to tolerances common to precision grinding for squareness, size and surface finish characteristics.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM FINISH SURFACE GRINDING OF FLAT SURFACES AT SIMPLE ANGLES WITH RESPECT TO ONE ANOTHER. DRESS THE WHEEL AS NECESSARY.

SURFACE GRINDING: FINISHING FLATS AT SIMPLE ANGLES

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench with a precision surface plate
- Surface grinder with a suitable magnetic chuck
- Part matching the material requirements of the surface grinding blueprint, material: O1 Tool Steel
- Magnetic sine chuck
- Sine bars
- Assorted parallels
- Angle plate or precision grinding vise
- Assorted clamps
- Composition hammer
- Assorted grinding wheels suitable for mounting to the spindle
- Files
- Magnetic base for indicators
- Surface gage of sufficient size
- Diamond dresser
- Required micrometers
- Combination set
- Dial test indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Bevel vernier protractor
- Inspection sine plates and/or sine bars
- Gage blocks
- Adjustable parallels
- Depth micrometer set
- Master square or magnetic square
- Surface condition
- Comparison gages
- Machinery's Handbook

WORK TO BE PERFORMED

Dress the wheel, grind the specified angled surfaces to a finish matching 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.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM THE PREPARATION AND BALANCING OF A GRINDING WHEEL 14" DIAMETER OR GREATER. PLACE THE WHEEL INTO SERVICE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Standard workbench
Cylindrical grinder
Appropriate grinding wheel: A2 Tool Steel
Wheel balancer, counterweights, wheel arbor
Dial test indicator and indicator mounting brackets
Machinery's Handbook

WORK TO BE PERFORMED

Prepare for mounting and mount a grinding wheel of 14" diameter or larger. Produce a surface finish of 32 microinches or better on a cylinder of Cold Rolled Steel (CRS).

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The grinding wheel produces 32 microinch or better finishes.
- Appropriate trade techniques and speeds and feeds are used to balance the wheel.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

SET UP AND PERFORM BETWEEN CENTERS GRINDING FOR STRAIGHT DIAMETERS. DRESS THE GRINDING WHEEL AS NECESSARY.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Cylindrical grinder
- Part matching the material requirements of the cylindrical grinding blueprint, material: A2 at 55 to 60 Rockwell c-scale (R_c)
- Centers for the headstock and tailstock
- Assorted grinding dogs
- Composition hammer
- Assorted grinding wheels suitable for mounting to the spindle
- Files
- Magnetic base for indicators
- Diamond dresser
- Required micrometer
- Combination set
- Dial test indicator
- 6" rule
- Gage blocks
- Surface condition comparison gages
- Machinery's Handbook

WORK TO BE PERFORMED

Dress the wheel. Mount the part between centers, and grind the required diameters to finish.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

OPERATE A PLUNGE ELECTRIC DISCHARGE MACHINE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprint detailing a part requiring milling, drilling, turning and grinding
- Sketches, notes
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Plunge EDM
- Workbench
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- Appropriate workholding device
- Screws, studs, nuts, washers and clamps to hold the part to the table
- Assorted parallels
- Adapters fitted to the electrode holder
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Assorted hand tools
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Edge finder
- Appropriate tools for determining squareness
- Surface finish comparison standards
- Machinery's Handbook

WORK TO BE PERFORMED

Perform the EDM operation called out on the process plan in conformance with the blueprint.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Part requiring the operations listed above
- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Components required to complete the assembly
- Standard plunge EDM
- Workbench
- A part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- An appropriate workholding device
- Screws, studs, nuts, washers and clamps to hold the part to the table
- Assorted parallels
- Adapters fitted to the electrode holder
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Assorted hand tools
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Edge finder
- Appropriate tools for determining squareness
- Surface finish comparison standards
- Machinery's Handbook

WORK TO BE PERFORMED

Perform the EDM operation called out on the blueprint and process plan.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

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USING A COMPUTER AND EDITOR SOFTWARE, WRITE SIMPLE RS274-D PROGRAMS. SIMPLE PROGRAMS ARE SINGLE PLANE, CUTTER CENTERLINE, LINEAR AND CIRCULAR INTERPOLATION AND SINGLE CUTTER WITH NO CANNED CYCLES.

COMPUTER NUMERICAL CONTROL (CNC): WRITING SIMPLE RS274-D PROGRAMS

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions for the task at hand
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Part matching the layout blueprint, material: 1018 Hot Rolled Steel (HRS)
Common workbench
Personal computer
Software editor
Printer
Diskette
Paper
Machinery's Handbook
Electronics Industries Association (EIA) standard RS274-D
Manual for the machine tool for which the program is being written

WORK TO BE PERFORMED

Write a program, including speeds and feeds, to drive an endmill through a continuous path around three sides of a part requiring the development of a linear interpolation tool path as well as circular interpolation. Store the program on computer media.

PERFORMANCE CRITERIA

The finished program matches the elements of the model program or alternate. Relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The program matches the model program, or an alternative program matches standard practices for such a program in the estimation of two designated examiners.
- All relevant questions are successfully answered regarding the program, tooling and equipment it involves.
- Appropriate trade techniques are used to produce the program.
- All relevant paperwork is completed and is in order.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the work and the projected work arising from the program.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- Files
- Wrenches as necessary
- Micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Standard workbench
- CNC mill with continuous path capability on 2½ axes
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps sufficient to secure the vise or the part to the table
- Assorted parallels
- Ball-peen and composition hammers
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Assorted cutters
- Required micrometers
- Adjustable parallels
- Edge finder
- Appropriate tools for determining squareness
- Machinery's Handbook
- Operator's manual for the machine tool

WORK TO BE PERFORMED

Operate a CNC mill, change tool values as necessary and replace and qualify tooling as necessary.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- CNC turning center of adequate capacity
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Part matching the material requirements of the CNC turning blueprint, material: 1215 Cold Rolled Steel (CRS)
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to the profile of the thread called out on the turning blueprint
- Drill chuck
- Centerdrill
- External undercut tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison standards
- Appropriate taper ring gages and Prussian blue or taper micrometer or sine bar and indicator
- Surface finish comparison plates
- Machinery's Handbook
- Operator's manual for the machine tool

WORK TO BE PERFORMED

Operate CNC lathe, change tool values as necessary and replace and qualify tooling as necessary.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM THE INSPECTION OF PROFILES IN SHADOW AND IN REFLECTION.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Optical comparator and necessary drafting supplies and equipment
Finished part matching the blueprint
Vellum or tracing paper
Tooling appropriate to the presentation of a part on an optical comparator
Precision tools needed to operate the comparator
Machinery's Handbook

WORK TO BE PERFORMED

Inspect a part's specified profiles. Produce data necessary to describe the compliance of the profiles.

PERFORMANCE CRITERIA

The inspection report satisfies the elements of the model report, appropriate techniques were used to gather the data for the report, paperwork is complete, housekeeping is accomplished and safe practices are used.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The inspection report findings match the findings of the model inspection report.
- Appropriate trade techniques are used to produce the inspection findings.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

SET UP AND PERFORM THE INSPECTION OF PARTS USING A CMM.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Coordinate Measuring Machine (CMM)
Finished part matching the blueprint
Tooling appropriate to the setup of a part on a CMM
Precision tools needed to establish the setup
Machinery's Handbook

WORK TO BE PERFORMED

Inspect a part's geometry. Produce data necessary to describe the compliance of the part.

PERFORMANCE CRITERIA

The inspection report satisfies the elements of the model report; appropriate techniques were used to gather the data for the report. Paperwork is complete, housekeeping is accomplished and safe practices are used.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The inspection report findings match the findings of the model inspection report.
- Appropriate trade techniques are used to produce the inspection findings.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

PARTICIPATE AS A TEAM MEMBER IN A CAPABILITY STUDY. PERFORM THE REQUIRED STATISTICAL CALCULATIONS TO SUPPORT THE CAPABILITY STUDY. WITH THE ASSISTANCE OF THE TEAM LEADER, PREPARE THE NECESSARY SHOP REPORTS FOR THE CAPABILITY STUDY.

PARTICIPATION IN CAPABILITY STUDIES

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Common workbench with a precision surface plate
Statistical study data
Capability study plan
Calculator with statistical functions or computer with statistical software
Calculator manual or software manual
Machinery's Handbook

WORK TO BE PERFORMED

Participate as a team member in support of the development of a capability study. With the direction of the team leader, provide all the machining expertise and statistical calculation needed to satisfy the requirements of the capability study.

PERFORMANCE CRITERIA

Explain the process capability study. Relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The team's activities in producing capability studies are explained successfully.
- All relevant questions are answered successfully regarding the studies.
- Appropriate trade techniques are used to produce the studies.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation being studied.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Common workbench with a lapping plate that can be fixed in place
Part ground to the lapping blueprint, material:
1215 Cold Rolled Steel (CRS)
Lapping compound and cleaning solution with appropriate disposal for both
Wipes
Optical flats
Indicators
Electronic gages
Laboratory grade surface plate
Transfer gage
Machinery's Handbook

WORK TO BE PERFORMED

Hand lap a surface to flatness and finish requirements.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM CONTOUR SAWING TO A LAYOUT WHICH REQUIRES THE PART TO BE SAWED AT ANGLES WITH RESPECT TO THE TOP AND/OR BOTTOM. CHOOSE AND MOUNT APPROPRIATE BLADES. WELD, BREAK AND REWELD BLADES AS NECESSARY.

ANGLE CONTOUR BANDSAWING

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench and appropriate bandsaw
- Part matching the bandsaw blueprint, material: 1215 Cold Rolled Steel (CRS)
- Scriber
- Layout ink
- Prick punch
- Ball-peen hammer
- Angle plate
- C-clamps
- Magnifying glass
- Combination set
- Radius gages
- 6" dividers
- Surface gage
- Layout height gage
- Files
- Machinery's Handbook

WORK TO BE PERFORMED

Finish saw a part to the layout maintaining the required angular relationships of the finish with respect to the top and/or bottom.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Tool room engine lathe (The lathe may have a quick-change gear box with the threads called for on the blueprint available from the gearbox.)
- Pedestal grinding machine to offhand grind form tools
- Part matching the material requirements of the turning blueprint, material: 1215 Cold Rolled Steel (CRS)
- Tool post
- Right- and left-hand turning tools capable of turning to a square shoulder
- Drill chuck
- Centerdrill
- External undercut tools
- 45° chamfer tools
- Assorted tool blanks for form tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Optical comparator
- Appropriate taper ring gages and Prussian blue or taper micrometer or sine bar and indicator
- Inspection templates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part matching the process plan and the blueprint specifications using appropriate trade techniques and speeds and feeds. The part specified should have at least two diameters composed of a taper and two tangent radii.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM TURNING AND BORING OPERATIONS REQUIRING A STEADY REST.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Steady rest
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Tool room engine lathe (The lathe may have a quick-change gear box with the threads called for on the blueprint available from the gear box.)
- Part matching the requirements of the turning blueprint, material: 1215 Cold Rolled Steel (CRS)
- Tool post
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to the profile of the thread called out on the turning blueprint
- Drill chuck
- Centerdrill
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary and cutting fluids
- Required micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring and plug gages
- Dial Indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Dial bore gages
- Surface finish comparison plates
- Indicator
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part matching the process plan and the blueprint specifications using appropriate trade techniques and speeds and feeds. The part specified will extend far enough from the spindle to require the support of a steady rest to facilitate boring on its ends. The part will have at least two bores within +/-.001", one Unified National Coarse (UNC) external thread and one Unified National Fine (UNF) external thread and will require the reversal of the part end for end.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM TURNING OPERATIONS BENEFITING FROM THE USE OF A FOLLOWER REST.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Tool room engine lathe
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Part matching the material requirements of the turning blueprint, material: 1215 Cold Rolled Steel (CRS)
- Tool post
- Follower rest
- Steady rest
- Right- and left-hand turning tools capable of turning to a square shoulder
- Drill chuck
- Centerdrill
- Drills
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Cutting fluids
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part matching the process plan and the blueprint specifications using appropriate trade techniques and speeds and feeds. The part specified will have at least three diameters within +/-.001", one of which will be an extended turn which will benefit from the use of a follower rest.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND PERFORM TURNING OF REFRACTORY MATERIALS.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Tool room engine lathe
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- 300 series stainless steel, except 303
- Tool post
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to the profile of the thread called out on the turning blueprint
- Drill chuck
- Centerdrill
- Drills
- External undercut tools
- 45° chamfer tools
- Live center
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Produce a part matching the process plan and the blueprint specifications using appropriate trade techniques and speeds and feeds. The part specified should have at least two diameters within +/-.001", one Unified National Coarse (UNC) external thread and one Unified National Fine (UNF) external thread.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND MILL FLAT SURFACES AT COMPOUND ANGLES WITH RESPECT TO EACH OTHER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Appropriate milling machine
- Part matching the requirements of the compound angle blueprint, material: 1215 Cold Rolled Steel (CRS)
- Required cutters and adapters
- Milling vise
- Toolmaker's vise
- Sine plates
- Tilting tables
- Clamps and studs
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Bevel vernier protractor
- Tooling ball
- Precision pins
- Sine bar
- Sine plate
- Gage blocks
- Surface plate
- Surface finish comparison plates
- Calculator with trig functions
- Machinery's Handbook

WORK TO BE PERFORMED

Mill compound angles. Inspect the angles using a sine bar or sine plate.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND MILL CURVED SURFACES THROUGH LINEAR MOVES OF VARYING LENGTHS USING METHODS OF APPROXIMATION FROM TAPERS, RADII, INTERPOLATION AND SECTIONED TEMPLATES.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- Required cutters and adapters
- Milling vise
- Toolmaker's vise
- Sine plates
- Tilting tables
- Template material
- Clamps and studs
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Bevel vernier protractor
- Tooling ball
- Precision pins
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Mill surfaces which are composed of nonlinear profiles.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND BORE A SERIES OF IN-LINE CONCENTRIC BORES USING LINE BORING TECHNIQUES AND THE BORING MILL FOOTSTOCK.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench
- Appropriate milling machine
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- Required cutters and adapters
- Boring bars and single point boring tools
- Milling vise
- Rotary table with power take off
- Clamps and studs
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Dial bore gages
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Bore and mill surfaces, diameters and radii to match the blueprint.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

PREPARE GRINDING WHEELS FOR MOUNTING A CYLINDRICAL GRINDER OR SURFACE GRINDER. MOUNT THE WHEEL AND GRIND A 16 MICROFINISH ON A SURFACE. DRESS AS NECESSARY.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Standard workbench and cylindrical grinder
Appropriate grinding wheels
Wheel balancer, counterweights, wheel arbor
Dial test indicator
Indicator mounting brackets
Machinery's Handbook

WORK TO BE PERFORMED

Given a wheel and appropriate equipment, prepare the wheel to go into service.

PERFORMANCE CRITERIA

The collection of wheels has been separated into acceptable and not acceptable categories, not acceptable wheels are labeled and secured from use, an acceptable wheel is mounted using safe and appropriate practices and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The collection of grinding wheels is evaluated correctly.
- The failed grinding wheels are labeled and appropriately secured from future use.
- Appropriate trade techniques are used to evaluate the wheels and to balance and mount the sound wheel.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary with the complexity of the operation.
- Safe practices are used throughout the performance.

SET UP AND GRIND TAPERS ON A CYLINDRICAL GRINDER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Standard workbench and cylindrical grinder
- Part matching the requirements of the cylindrical grinding blueprint, material: 1215 Cold Rolled Steel (CRS)
- Centers for the headstock and tailstock
- Assorted grinding dogs
- Composition hammer
- Assorted grinding wheels suitable for mounting to the spindle
- Files
- Magnetic base for indicators
- Diamond dresser
- Required micrometers
- Combination set
- Dial test indicator
- 6" rule
- Gage blocks
- Surface condition comparison gages
- Appropriate taper ring gages and Prussian blue or taper micrometer or sine bar and indicator
- Machinery's Handbook

WORK TO BE PERFORMED

Mount a part, rough finished as a Morse taper, between centers; and grind the required tapered diameter to finish. Dress the wheel as necessary.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND GRIND ID AND OD SURFACES ON A UNIVERSAL GRINDING MACHINE OR ID/OD GRINDER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Part requiring the operations listed above
- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Components required to complete the assembly
- Standard workbench and ID/OD grinder
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- Workholders
- Three- and four-jaw grinder's chucks
- Composition hammer
- Assorted grinding wheels suitable for mounting to the spindle
- Files
- Magnetic base for indicators
- Diamond dresser
- Required micrometers
- Dial bore gages
- Dial test indicator
- 6" rule
- Gage blocks
- Surface condition comparison gages
- Machinery's Handbook

WORK TO BE PERFORMED

Mount a part, rough finished on Outside Diameters and Inside Diameters, in an appropriate workholder; and grind the diameters to the required finish. Grind the shoulders as necessary. Dress the wheel.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions for the task at hand
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Standard workbench and universal grinder
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- Workholders
- Three- and four-jaw grinder's chucks
- Centers
- Drive dogs
- Indexers
- Composition hammer
- Assorted grinding wheels suitable for mounting to the spindle
- Files
- Magnetic base for indicators
- Live center
- Tailstock
- Diamond dresser
- Required micrometers
- Dial bore gages
- Dial test indicator
- 6" rule
- Gage blocks
- Surface condition comparison gages
- Appropriate taper ring gages and Prussian blue or taper micrometer or sine bar and indicator
- Machinery's Handbook

WORK TO BE PERFORMED

Mount a part, rough finished on Outside Diameters and Inside Diameters, in an appropriate workholder; and grind the tapered diameters to the required finish. Dress the wheel.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND GRIND CURVED AND IRREGULAR SURFACES BY USING LINEAR INCREMENTAL MOVES, TAPERS, RADII, INTERPOLATION AND APPROXIMATION WITH THE AID OF A VISUAL COMPARATOR AND A RADIUS DRESSER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- Standard workbench and profile grinder
- Part matching the material requirements of the blueprint, material: A2 Tool Steel
- Workholders
- Grinder's vise
- Composition hammer
- Machinery's Handbook
- Assorted grinding wheels suitable for mounting to spindle
- Files
- Magnetic base for indicators
- Radius dresser
- Diamond dresser
- Required micrometers
- Dial test indicator
- 6" rule
- Gage blocks
- Visual comparator
- Surface condition comparison gages

WORK TO BE PERFORMED

Mount the part in an appropriate workholder, and grind the profile to the required finish. Dress the wheel as necessary.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

OPERATE A 4-AXIS WIRE ELECTRIC DISCHARGE MACHINE.

ELECTRIC DISCHARGE MACHINE (EDM): OPERATING A 4-AXIS WIRE EDM

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Common workbench
- 4-axis wire Electric Discharge Machine (EDM) and a workbench
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- Appropriate workholding device
- Screws, studs, nuts, washers and clamps sufficient to secure the part to the table
- Assorted parallels
- Files
- Magnetic base for indicators
- Assorted hand tools
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Edge finder
- Appropriate tools for determining squareness
- Surface finish comparison standards
- Machinery's Handbook

WORK TO BE PERFORMED

Perform the EDM operation called out on the process plan.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

USING A COMPUTER AND EDITOR, WRITE SOPHISTICATED RS274-D PROGRAMS. SOPHISTICATED PROGRAMS WILL CONTAIN VARIOUS COMBINATIONS OF CHANGE OF PLANE AND CANNED CYCLES AND EMPLOY MULTIPLE TOOLS; CUTTER OFFSETS AND LINEAR, CIRCULAR AND HELICAL INTERPOLATION AS WELL AS REQUIRE THE MATCHING OF SURFACES ALONG LINES AND POINTS OF TANGENCY IN THREE AXES. STORE THE RESULTS ON COMPUTER MEDIA.

COMPUTER NUMERICAL CONTROL (CNC): ADVANCED MANUAL RS274-D PROGRAMMING

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Common workbench
Personal computer
Software editor
Printer
Diskette
Paper
Machinery's Handbook
Electronics Industries Association (EIA) standard RS274-D
Relevant manuals for the machine tool for which the program is being written

WORK TO BE PERFORMED

Write a program to drive a collection of tooling through the toolpaths needed to produce the part shown on the blueprint. The program will require change of tools, change of planes and use of "canned cycles" and tool offsets. Use a computer to write and store the program.

PERFORMANCE CRITERIA

The program matches the elements of the model program or alternate program, relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

ASSESSMENT AND CREDENTIALING APPROACH

- The program matches the model program, or an alternative program matches standard practices for such a program in the estimation of two designated examiners.
- All relevant questions are successfully answered regarding the program, tooling and equipment it involves.
- Appropriate trade techniques are used to produce the program.
- All relevant paperwork is completed and is in order.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the work and the projected work arising from the program.

CREATE RS274-D PROGRAMS USING A MANUFACTURING MODELING SOFTWARE PACKAGE.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

Blueprints, sketches, notes
Completed process plan
Verbal instructions
Production schedule
Tool crib with relevant perishable tooling
Tool crib with relevant precision measuring tools
Machine tool and accessory inventory
Personal computer
Graphics-based tool path modeler/editor
Software editor
Printer
Diskette
Paper
Machinery's Handbook
Electronics Industries Association (EIA) standard RS274-D
Relevant manuals for the machine tool for which the program is being written

WORK TO BE PERFORMED

Use a graphics-based software package to develop a program to drive a collection of tooling through the toolpaths needed to produce the part shown on the blueprint. The program will require change of tools, change of planes and use of "canned cycles" and tool offsets.

PERFORMANCE CRITERIA

The program matches the elements of the model program or alternate program, relevant questions are answered, appropriate safety and trade techniques are employed and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The program matches the model program, or an alternative program matches standard practices for such a program in the estimation of two designated examiners.
- All relevant questions are successfully answered regarding the program, tooling and equipment it involves.
- Appropriate trade techniques are used to produce the program.
- All relevant paperwork is completed and is in order.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the work and the projected work arising from the program.

SET UP AND OPERATE A CNC MILLING CENTER.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- CNC mill with continuous path capability on 2½ axes
- Part matching the material requirements of the blueprint, material: 1215 Cold Rolled Steel (CRS)
- 6" milling vise or greater
- Screws, studs, nuts, washers and clamps sufficient to secure the vise or the part to the table
- Assorted parallels
- Assorted cutters and cutter adapters fitted to the machine spindle
- Files
- Magnetic base for indicators
- Soft jaws for the vise
- Required micrometers
- Combination set
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Adjustable parallels
- Edge finder
- Appropriate tools for determining squareness
- Surface finish comparison plates
- Machinery's Handbook

WORK TO BE PERFORMED

Set up the tooling and workpiece. Qualify the workpiece to the control. Prepare tools or load tools into tool magazine as required; qualify the tools to the control with respect to the work; match their identity to the program. Establish initial tool values or offsets. The part specified should have at least two steps with +/-.001" tolerances, one Unified National Coarse (UNC) tapped hole and an arc/tangent surface and require the use of at least one "canned cycle" available on the mill.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- CNC turning center of adequate capacity
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Part matching the material requirements of the CNC turning blueprint, material: 1215 Cold Rolled Steel (CRS)
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to the profile of the thread called out on the turning blueprint
- Drill chuck
- Centerdrill
- External undercut tools
- Live center
- Dead center fitted to the spindle taper
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Appropriate taper ring gages and Prussian blue or taper micrometer or sine bar and indicator
- Machinery's Handbook

WORK TO BE PERFORMED

Set up the tooling and workpiece. Qualify the workpiece to the control. Prepare tools or load tools into tool magazine as required; qualify the tools to the control with respect to the work; match their identity to the program. Establish initial tool values or offsets. The part specified should have at least two diameters within +/-.001", one Unified National Coarse (UNC) external thread, one Unified National Fine (UNF) external thread and an appropriate taper at each end of the part and require an end-for-end swap.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

SET UP AND OPERATE TURNING CENTERS WITH SECONDARY MILLING OPERATIONS.

COMPUTER NUMERICAL CONTROL (CNC): TURNING CENTERS WITH SECONDARY MILLING

SKILL STANDARD

CONDITIONS OF PERFORMANCE

Given the following:

- Blueprints, sketches, notes
- Completed process plan
- Verbal instructions
- Production schedule
- Tool crib with relevant perishable tooling
- Tool crib with relevant precision measuring tools
- Machine tool and accessory inventory
- Common workbench
- CNC turning center of adequate capacity
- Three-jaw universal scroll chuck
- Four-jaw independent chuck
- Part matching the material requirements of the CNC turning blueprint, material: 1215 Cold Rolled Steel (CRS)
- Right- and left-hand turning tools capable of turning to a square shoulder
- External threading tool matched to the profile of the thread called out on the blueprint
- Drill chuck
- Centerdrill
- Drills
- Endmills
- External undercut tools
- 45° chamfer tools
- Live center
- Dead center fitted to the spindle tape
- Magnetic base for a dial indicator
- Files
- Wrenches as necessary
- Required micrometers
- Combination set
- Thread-pitch gages
- Center gage
- Pitch micrometer
- Thread-ring gages
- Dial indicator
- 6" rule
- 6" vernier, dial or electronic caliper
- Surface finish comparison plates
- Appropriate taper ring gages and Prussian blue or taper micrometer or sine bar and indicator
- Machinery's Handbook

WORK TO BE PERFORMED

Set up the tooling and workpiece. Qualify the workpiece to the control. Prepare tools or load tools into tool magazine as required; qualify the tools to the control with respect to the work; match their identity to the program. Establish initial tool values or offsets. The part specified should have at least two diameters within +/-.001", one Unified National Coarse (UNC) external thread, one Unified National Fine (UNF) external thread, an appropriate taper at each end of the part and a keyseat and crosshole requiring the secondary milling capability of the center.

PERFORMANCE CRITERIA

The part meets specifications, production and safety practices are appropriate and paperwork is completed.

PERFORMANCE ELEMENTS AND ASSESSMENT CRITERIA

- The part is produced to specification.
- Appropriate trade techniques and speeds and feeds are used to produce the part.
- All relevant paperwork is completed and is in order.
- The work area is returned to a neat and clean state.
- The time will vary according to the complexity of the part being produced. For current blueprints, equipment list and suggested times, contact the National Institute for Metalworking Skills at 703/281-1610.
- Safe practices are used throughout the performance.

Academic Skills	Skills (and related knowledge) contained in the subject areas and disciplines addressed in most national and state educational standards, including English, mathematics, science, etc.
Assessment	A process of measuring performance against a set of standards through examinations, practical tests, performance observations and/or the completion of work portfolios.
Content Standard	A specification of what someone should know or be able to do to successfully perform a work activity or demonstrate a skill.
Critical Work Functions	Distinct and economically meaningful sets of work activities critical to a work process or business unit which are performed to achieve a given work objective with work outputs that have definable performance criteria. A critical work function has three major components: • **Conditions of Performance:** The information, tools, equipment and other resources provided to a person for a work performance. • **Work to Be Performed:** A description of the work to be performed. • **Performance Criteria:** The criteria used to determine the required level of performance. These criteria could include product characteristics (e.g., accuracy levels, appearance), process or procedure requirements (e.g., safety, standard professional procedures) and time and resource requirements. The IOSSCC requires that these performance criteria be further specified by more detailed individual performance elements and assessment criteria.
Credentialing	The provision of a certificate or award to an individual indicating the attainment of a designated set of knowledge and skills and/or the demonstration of a set of critical work functions for an industry/ occupational area.
Illinois Occupational Skill Standards and Credentialing Council (IOSSCC)	Legislated body representing business and industry which establishes skill standards criteria, endorses final products approved by the industry subcouncil and standards development committee and assists in marketing and dissemination of occupational skill standards.
Industry	Type of economic activity, or product or service produced or provided in a physical location (employer establishment). They are usually defined in terms of the Standard Industrial Classification (SIC) system.

Industry Subcouncil	Representatives from business/industry and education responsible for identifying and prioritizing occupations for which occupational performance skill standards are adapted, adopted or developed. They establish standards development committees and submit developed skill standards to the IOSSCC for endorsement. They design marketing plans and promote endorsed skill standards across the industry.
Knowledge	Understanding the facts, principles, processes, methods and techniques related to a particular subject area, occupation or industry.
Occupation	A group or cluster of jobs, sharing a common set of work functions and tasks, work products/services and/or worker characteristics. Occupations are generally defined in terms of a national classification system including the Standard Occupational Classification (SOC), Occupational Employment Statistics (OES) and the Dictionary of Occupational Titles (DOT).
Occupational Cluster	Grouping of occupations from one or more industries that share common skill requirements.
Occupational Skill Standards	Specifications of content and performance standards for critical work functions or activities and the underlying academic, workplace and occupational knowledge and skills needed for an occupation or an industry/occupational area.
Occupational Skills	Technical skills (and related knowledge) required to perform the work functions and activities within an occupation.
Performance Standard	A specification of the criteria used to judge the successful performance of a work activity or the demonstration of a skill.
Product Developer	Individual contracted to work with the standard development committee, state liaison, industry subcouncil and IOSSCC for the adaptation, adoption or development of skill standards content.
Reliability	The degree of precision or error in an assessment system so repeated measurements yield consistent results.
Skill	A combination of perceptual, motor, manual, intellectual and social abilities used to perform a work activity.
Skill Standard	Specifies the knowledge and competencies required to perform successfully in the workplace.

Standards Development Committee	Incumbent workers, supervisors and human resource persons within the industry who perform the skills for which standards are being developed. Secondary and postsecondary educators are also represented on the committee. They identify and verify occupational skill standards and assessment mechanisms and recommend products to the industry subcouncil for approval.
State Liaison	Individual responsible for communicating information among all parties (IOSSCC, subcouncil, standard development committee, product developer, project director, etc.) in skill standard development.
Third-Party Assessment	An assessment system in which an industry-designated organization (other than the training provider) administers and controls the assessment process to ensure objectivity and consistency. The training provider could be directly involved in the assessment process under the direction and control of a third-party organization.
Validity	The degree of correspondence between performance in the assessment system and job performance.
Workplace Skills	The generic skills essestial to seeking, obtaining, keeping and advancing in any job. These skills are related to the performance of critical work functions across a wide variety of industries and occupations including problem solving, leadership, teamwork, etc.

Margaret Blackshere	AFL-CIO
Hollis Earnest	Manufacturing/Electronics
David Emerson	Downstate National Bank
Bernard Gregory	Passavant Hospital
Michael O'Neill	
Janet Payne	United Samaritans Medical Center
Gerald Schmidt	Illinois Manufacturing Association Caterpillar, Inc.
Jim Schultz	Illinois Retail Merchants Association Walgreen Company
Larry Vaughn	The Illinois State Chamber of Commerce Alternative School Network

Blouke Carus	President and Chief Executive Officer Carus Corporation
Gerson Ecker	Becker-Erhardt Company
George Knecht	Subdistrict Director United Steelworkers of America
Ken Knott	Business Agent District 9 Machinists
Steve Kopinski	Vice President Northwestern Tool & Die Manufacturing Corporation
Harry Litchfield	Deere & Company
Renee Loth	LoDan Electronics, Inc.
George Marshall	Hoffer Plastics
Bob Shaw	Lewis and Clark College
Norm Sherck	Information Staff Representative United Auto Workers
Gary Smith	General Manager Manufacturers' Brass and Aluminum Foundry
Norbert Stengel	President Northwestern Tool & Die Manufacturing Corporation
Gabe Verstraete	United Township High School
Marvin Wortell	Chairman Triton Industries, Inc.
Peter Wrenn	President Hudson Screw Machine Products Company

Diane Yasko	Motorola, Inc.
Ronald Engstrom	State Liaison Illinois State Board of Education
Dennis Gallo	State Liaison Illinois State Board of Education

APPENDIX D

MACHINING SKILLS CLUSTER STANDARDS DEVELOPMENT COMMITTEE

Jerry Benish	Cam Craft
Tim Doran	Tristate Machinery
Joel Godberg	Kaan Engineering
Glen Marcantoni	Die Masters
Helmut Mueller	Helm Tool
Manfred Mueller	Northwestern Tool & Die Manufacturing Corporation
Tim Piper	Piper Tool & Die
John Stinebring	S & C Electric
Del Tyre	D. Tyre Tech

Brian Keefe	Product Developer Northern Illinois University Business and Industry Services
Ronald Engstrom	State Liaison Illinois State Board of Education
Dennis Gallo	State Liaison Illinois State Board of Education

I. Occupational Definition and Justification

A. Occupational Definition

The Manufacturing Subcouncil identified machining skills as a major occupational cluster in manufacturing. Machining skills involve the use of cutting tools to shape metal materials in single-part and serial manufacturing by means of milling, turning, grinding, boring and sawing with a variety of conventional and computer numerical control (CNC) machines and associated tooling.

The National Institute for Metalworking Skills (NIMS) has developed national standards for three levels of machining skills. The Manufacturing Subcouncil voted to endorse these national standards for Illinois as reformatted to meet the format requirements of the Illinois Occupational Skill Standards and Credentialing Council (IOSSCC).

The IOSSCC-recognized standards will be referred to as the "Illinois Machining Skill Standards adapted from the National Machining Skill Standards to meet the format requirements of the Illinois Occupational Skill Standards and Credentialing Council."

These machining skills are used predominately in the following occupations recognized by the Tooling and Manufacturing Association in their analysis of labor market needs in Illinois.

- Machinist
- Machine Tool Setters and Set-up Operators
- Metal Processing Machine Setters and Setup Operators
- Combination Machine Setters and Setup Operators
- Numerical Control Machine Setters and Setup Operators
- Tool and Die/Mold Maker

B. Employment and Earnings Opportunities

These machining occupations have a generally favorable employment outlook in Illinois according to the Illinois Occupational Information Coordinating Committee (IOICC) based on data provided by the Tooling and Manufacturing Association and the Illinois Department of Employment Security. These machining occupations are projected to have a large number of job openings in the future due to growth and replacement needs.

These machining occupations also meet the IOSSCC earnings criteria based on data provided by the IOICC and shown below. These earnings represent the range between the 25th and the 75th percentile.

- Machinist ..... $23,570 - $31,990
- Machine Tool Setters and Set-up Operators ..... $15,930 - $22,190
- Metal Processing Machine Setters and Setup Operators ..... $20,700 - $27,560
- Combination Machine Setters and Setup Operators ..... $24,090 - $31,200
- Numerical Control Machine Setters and Setup Operators ..... $24,770 - $33,090

According to the wage surveys of the Tooling and Manufacturing Association, individuals with these machining skills can earn salaries substantially higher than those shown above.

C. Career Opportunities and Education and Training Requirements

Machining skills meet the IOSSCC criteria for education and training requirements and career opportunities. Machining skills require basic workplace skills and advanced technical training for all three skill levels. The workplace skill requirements are detailed in the knowledge, skills and other attributes provided in the standards document. The technical skill requirements are detailed in the technical elements portion of the standards document.

II. Occupational Standards and Credentials

A. Occupational Skill Standards

The Machining Skill Standards Levels I-III as developed by the NIMS meet all IOSSCC content requirements and have been translated into the IOSSCC format. The translation to IOSSCC formats required no major changes in the national standards.

B. Assessment and Credentialing System

The National Institute for Metalworking Skills (NIMS) is developing both written and performance examinations for Machining Skills Levels I-III. These examinations are now being pilot-tested and will be available for use in Illinois. The assessment and credentialing process meets all IOSSCC criteria.

III. Industry Support and Commitment

A. Industry Commitment for Development and Updating

The National Institute for Metalworking Skills conducted a national validation of the national machining skill standards through regional technical groups and national surveys. The Illinois Manufacturing Subcouncil established a standards development committee to approve the national standards and the reformatting of the standards. This standards development committee received a mail survey with the reformatted standards. The survey returns recommended endorsement of the national standards and approval of the reformatting. The Manufacturing Subcouncil then voted to endorse the national standards as reformatted.

The NIMS is committed to maintaining and updating the national machining skill standards for use in Illinois and other states. The NIMS board is composed of representatives of leading industry and trade associations and unions in the industry.

B. Industry Commitment for Marketing

The NIMS and affiliated Illinois organizations are committed to promoting and marketing the national machining standards and credentialing system in Illinois. The NIMS and the Tooling and Manufacturing Association have committed to promote the standards in Illinois.

A. Developing an Employment Plan	1. Match interests to employment area. 2. Match aptitudes to employment area. 3. Identify short-term work goals. 4. Match attitudes to job area. 5. Match personality type to job area. 6. Match physical capabilities to job area. 7. Identify career information from counseling sources. 8. Demonstrate a drug-free status.
B. Seeking and Applying for Employment Opportunities	1. Locate employment opportunities. 2. Identify job requirements. 3. Locate resources for finding employment. 4. Prepare a resume. 5. Prepare for job interview. 6. Identify conditions for employment. 7. Evaluate job opportunities. 8. Identify steps in applying for a job. 9. Write job application letter. 10. Write interview follow-up letter. 11. Complete job application form. 12. Identify attire for job interview.
C. Accepting Employment	1. Apply for social security number. 2. Complete state and federal tax forms. 3. Accept or reject employment offer. 4. Complete employee's Withholding Allowance Certificate Form W-4.
D. Communicating on the Job	1. Communicate orally with others. 2. Use telephone etiquette. 3. Interpret the use of body language. 4. Prepare written communication. 5. Follow written directions. 6. Ask questions about tasks.
E. Interpreting the Economics of Work	1. Identify the role of business in the economic system. 2. Describe responsibilities of employee. 3. Describe responsibilities of employer or management. 4. Investigate opportunities and options for business ownership. 5. Assess entrepreneurship skills.
F. Maintaining Professionalism	1. Participate in employment orientation. 2. Assess business image, products and/or services. 3. Identify positive behavior. 4. Identify company dress and appearance standards. 5. Participate in meetings in a positive and constructive manner. 6. Identify work-related terminology. 7. Identify how to treat people with respect.

G. Adapting to and Coping with Change	1. Identify elements of job transition. 2. Formulate transition plan. 3. Identify implementation procedures for a transition plan. 4. Evaluate the transition plan. 5. Exhibit ability to handle stress. 6. Recognize need to change or quit a job. 7. Write a letter of resignation.
H. Solving Problems and Critical Thinking	1. Identify the problem. 2. Clarify purposes and goals. 3. Identify solutions to a problem and their impact. 4. Employ reasoning skills. 5. Evaluate options. 6. Set priorities. 7. Select and implement a solution to a problem. 8. Evaluate results of implemented option. 9. Organize workloads. 10. Assess employer and employee responsibility in solving a problem.
I. Maintaining a Safe and Healthy Work Environment	1. Identify safety and health rules/procedures. 2. Demonstrate the knowledge of equipment in the workplace. 3. Identify conservation and environmental practices and policies. 4. Act during emergencies. 5. Maintain work area. 6. Identify hazardous substances in the workplace.
J. Demonstrating Work Ethics and Behavior	1. Identify established rules, regulations and policies. 2. Practice cost effectiveness. 3. Practice time management. 4. Assume responsibility for decisions and actions. 5. Exhibit pride. 6. Display initiative. 7. Display assertiveness. 8. Demonstrate a willingness to learn. 9. Identify the value of maintaining regular attendance. 10. Apply ethical reasoning.
K. Demonstrating Technological Literacy	1. Demonstrate basic keyboarding skills. 2. Demonstrate basic knowledge of computing. 3. Recognize impact of technological changes on tasks and people.
L. Maintaining Interpersonal Relationships	1. Value individual diversity. 2. Respond to praise or criticism. 3. Provide constructive praise or criticism. 4. Channel and control emotional reactions. 5. Resolve conflicts. 6. Display a positive attitude. 7. Identify and react to sexual intimidation/harassment.
M. Demonstrating Teamwork	1. Identify style of leadership used in teamwork. 2. Match team member skills and group activity. 3. Work with team members. 4. Complete a team task. 5. Evaluate outcomes.

WRITTEN AND ORAL COMMUNICATION

		LEVELS		
		1	2	3
READING	Locates, understands and interprets written technical and non-technical 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 multi-step directions. All documents are written in standard English.	●	●	●
WRITING	Communicates technical and non-technical 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. This writing includes the use of coherent paragraphs composed of complete sentences.	●	●	●
SPEAKING	Communicates technical and non-technical detailed information, messages, multi-step 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.	●	●	●
LISTENING	Listens for, receives, interprets and recalls specific details, ideas and multi-step 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 non-technical verbal information.	●	●	●

MATHEMATICS

		LEVELS		
		1	2	3
ARITHMETIC	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.	●		

Continued

	LEVELS		
	1	2	3
APPLICATIONS OF GEOMETRY			
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.	●		
GEOMETRY OF SIMPLE ANGLES AND PROFILES OF A LINE			
Applies principles of Euclidean geometry to the production of simple angles and profiles of a line.		●	
GEOMETRY OF COMPOUND ANGLES, PROFILES OF A LINE AND PROFILES OF A SURFACE			
Applies principles of Euclidean geometry to the production of compound angles, profiles of a line and profiles of a surface.			●
COORDINATE AXES, CARTESIAN AND POLAR			
Identifies points on a line, in a plane and in three space using Cartesian and polar coordinates.		●	
APPLICATIONS IN ALGEBRA			
Uses standard formulas and arithmetic operations to make required calculations with or without a calculator. Can solve for an unknown in a trade formula.	●		
APPLICATIONS IN TRIGONOMETRY			
Uses standard formulas and arithmetic operations to make required calculations with or without a calculator, solving for unknowns in right triangles.	●		
TRIGONOMETRY FOR CNC TOOLPATHS			
Applies trigonometry to the solution of geometric position problems for CNC toolpaths. Decomposes position problems to the solution of right and oblique triangles.		●	
APPLICATIONS OF STATISTICS			
Uses standard formulas and arithmetic operations to calculate means, medians, modes and ranges with or without a calculator.	●		
STATISTICS FOR CAPABILITY STUDIES			
Applies statistical tools to the development of statistical process monitoring and control tools.		●	

Adapted from the National Machining Skill Standards to meet the format requirements of the Illinois Occupational Skill Standards and Credentialing Council.

DECISION MAKING AND PROBLEM SOLVING

	LEVELS		
	1	2	3
APPLYING DECISION RULES			
Can follow a set of instructions laid out in a sequence. Can interpret and follow "if...then..." instructions.	●	●	●
BASIC PROBLEM SOLVING			
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.	●	●	●

SOCIAL SILLS AND PERSONAL QUALITIES

	LEVELS		
	1	2	3
SOCIAL SKILLS			
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.	●	●	●
PERSONAL QUALITIES			
Identifies and demonstrates the appropriate personal qualities in performing major job duties and maintaining positive employment relations.	●	●	●

ENGINEERING DRAWINGS AND SKETCHES

	LEVELS		
	1	2	3
STANDARD ORTHOGRAPHIC BLUEPRINTS			
Interprets orthographic blueprints.	●		
ISOMETRIC AND ORTHOGRAPHIC SKETCHING			
Sketches orthographic and isometric projections of parts or details to support nonverbal communication.		●	●
GDT ORTHOGRAPHIC BLUEPRINTS			
Interprets GDT orthographic blueprints.	●		
INTERPRETING ENGINEERING DRAWINGS: GEOMETRIC DIMENSIONING AND TOLERANCING			
Reads and interprets GDT drawings with multiple datums.		●	●
INTERPRETING ENGINEERING DRAWINGS: AUXILIARY VIEWS			
Reads and interprets engineering drawings having multiple auxiliary views.		●	●

MEASUREMENT		LEVELS		
BASIC MEASURNG INSTRUMENTS		1	2	3
	Recognizes and applies basic measuring instruments such as rules, protractors and basic transfer tools such as simple inside and outside calipers.	●	●	
PRECISION MEASURING INSTRUMENTS				
	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.	●		
SURFACE PLATE INSTRUMENTS				
	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.	●		
MANUAL COORDINATE MEASURING MACHINES				
	Applies the capacities of CMMs to inspection.		●	●

METALWORKING THEORY		LEVELS		
CUTTING THEORY		1	2	3
	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.	●	●	
TOOLING				
	Recognizes a wide variety of cutting tools, tool-holding devices and work-holding devices. Understands the appropriate application of these cutters and devices.	●		
MATERIAL PROPERTIES				
	Recognizes common materials and their principal properties relevant to machining tasks. Recognizes differences between ferrous and non-ferrous, magnetic and ductile materials. Understands the changes which heat-treat imparts to materials.	●		
MACHINE TOOLS				
	Recognizes the common classes of machine tools, understands the function of the major subsystems of the machine tools; selects and applies a given machine tool appropriately.	●		

Continued

METALWORKING THEORY *Continued*

	LEVELS		
	1	2	3
EDM: ELECTRODE SELECTION AND DESIGN			
Identifies the critical design and material characteristics of an electrode with respect to various materials to be machined.		●	
CNC MACHINE TOOLS			
Uses and applies the concepts of how CNC machine tools operate.		●	
CNC TOOLING			
Uses and applies the concepts of tooling with properties customized to the CNC environments of mills and lathes.		●	
CUTTING FLUIDS AND COOLANTS			
Recognizes, selects and applies appropriate coolants and coolant delivery systems.	●		
Identifies and applies the properties of coolants and/or cutting fluids with respect to the tooling, materials, material condition and the machine tool and its delivery systems. Takes the appropriate safety-related measures.		●	

APPLIED MATERIALS

	LEVELS		
	1	2	3
APPLY THE PROPERTIES OF VARIOUS METALS TO CUTTING PROBLEMS			
Determine appropriate cutting technique based partially upon metallurgical properties of a class of materials.		●	
APPLY THE PROPERTIES OF VARIOUS NON-METALS TO CUTTING PROBLEMS			
Determines appropriate cutting techniques based partially upon cutting properties of a material.		●	

COMPUTERS

	LEVELS		
	1	2	3
TYPING			
Types a short program.		●	
USE THE BASIC SERVICES OF AN OPERATING SYSTEM			
Formats a diskette. Creates and stores a data file. Retrieves a data file. Changes and resaves a data file.		●	

COMPUTER AIDED MANUFACTURING TECHNOLOGY

	LEVELS		
	1	2	3
COMPUTER-AIDED MANUFACTURING SOFTWARE			
Applies computer-aided manufacturing software to the development of information necessary to manufacture parts.			●

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