

# Machine Operator

## Addition and Subtraction

### Objectives:

- Define the following terms: whole number, numeral, digit, decimal, place value, addend, sum, minuend, subtrahend, and difference
- Properly place commas in large numbers
- Explain the significance of the digit zero in a number
- Differentiate between concrete and abstract numbers
- Properly prepare numbers for addition and subtraction
- Perform addition and subtraction on numbers
- Check your answers to both addition and subtraction problems
- Use a calculator to add and subtract numbers

## Multiplication and Division

### Objectives:

- Define the following terms: factor, multiplicand, multiplier, partial product, product, dividend, divisor, quotient, and remainder
- Recognize the various signs used for multiplication and division
- Properly prepare numbers for multiplication and division
- Perform multiplication and division on whole numbers, decimal numbers, and mixed decimal numbers
- Check your answers to both multiplication and division problems
- Find the average of a group of numbers
- Use a calculator to multiply and divide numbers

## Fractions, Percents, Proportions, and Angles

### Objectives:

- Define the following terms: fraction, proper fraction, improper fraction, lowest common denominator, percent, ratio, and proportion
- Add, subtract, multiply, and divide fractions
- Change fractions to decimals and decimals to fractions
- Solve problems involving percent
- Work with ratios and equivalent ratios
- Solve proportion problems
- Use a protractor to measure angles
- Lay out templates for checking angles
- Use a calculator to solve percent problems, to convert fractions to decimals, and to calculate missing terms in proportions

## Metric System

### Objectives:

- Name the base units most commonly used in the metric system and identify what they're used to measure
- Identify metric prefixes and their values
- Apply conversion factors to create a unit that's larger or smaller than the base unit
- Estimate lengths in metric units
- Express temperature in degrees Celsius
- Define the terms mass, density, force, torque, and pressure, and identify the metric units used to measure each one
- Use a conversion table to convert metric units to English units and English units to metric units
- Use a calculator to perform metric conversions

## Formulas

### Objectives:

- Explain the use of variables in formulas
- Prepare and use formulas to solve problems
- Use formulas to calculate the perimeter of a triangle and a rectangle, and the area of a triangle, a rectangle, and a circle
- Use formulas to calculate distance, current in a circuit, and the volume of a pyramid and a sphere
- Use a calculator to find square roots and solve formulas
- Substitute given numerical values for letters in a formula and find the unknown quantity
- Transform and solve equations and formulas

## Introduction to Algebra

### Objectives:

- Explain the difference between positive and negative numbers and their uses
- Perform basic arithmetic operations with signed numbers
- Raise a number to any power
- Use the order of operations for solving problems involving multiple operations
- Define the following words: term, constant, coefficient, exponent, monomial, trinomial, and polynomial
- Identify and combine like terms in an expression
- Perform basic arithmetic operations with signed terms
- Multiply and divide terms containing exponents  $n$
- Remove parentheses from an expression and simplify the expression

## Linear Distance and Measurement

### Objectives:

- Measure using both English and metric units of length
- Calculate the perimeters of rectangles, squares, and triangles
- Calculate the areas of objects such as rooms or machine bases
- Calculate the circumference of circular objects such as pipes or tanks
- Measure distances using rigid and flexible rules, thickness gages, and screw pitch gages
- Make precise measurements using vernier calipers and micrometers

## Bulk Measurement

### Objectives:

- Measure an angle by degrees
- Find the areas of rectangles, triangles, and circles
- Find the volumes of prisms, cylinders, and cones
- Find the mass of material stored in a container
- Determine the amount of material that can be stored or handled
- Discuss the types and uses of conveyors and weighing systems

## Temperature Measurement

### Objectives:

- Change temperature units from one system to another
- Discuss the use of the various types of thermometers
- Select the type of thermometer to be used at certain temperatures

## Energy, Force, and Power

### Objectives:

- Distinguish among the concepts of energy, force, and power
- Explain what the term work means and how it's measured
- Know by sight the basic machines: lever, inclined plane, wedge, wheel and axle, and screw
- Solve simple problems that involve levers, mechanical advantage, and machine efficiency
- List the forms of energy that have important industrial applications and the instruments used for measuring energy

## Fluid Measurement

### Objectives:

- Understand the properties of fluids
- Determine the density, specific gravity, and viscosity of fluids
- Express pressure in three different units
- Measure the pressure of fluids using manometers and Bourdon tube pressure gages
- Measure the flow rate of fluids using different types of flowmeters

## Manufacturing Processes, Part 1

### Objectives:

- Understand and describe the evolution of modern manufacturing before and since the industrial revolution of the 1800s
- Understand and describe the importance of developments in manufacturing such as standardization and mass production
- Understand the importance of and advances in typical manufacturing materials and their effect on manufacturing locations and techniques
- Understand and describe the role of quality assurance in manufacturing operations
- Describe and categorize the basic types of manufacturing organizational structure

## Manufacturing Processes, Part 2

### Objectives:

- Describe the four basic classifications of materials used for manufacturing processes
- Understand the essential metallurgical characteristics of steel and ferrous alloys, and types of steel for different applications
- List the important properties of nonferrous alloys
- Explain the effect material choices have on the subsequent manufacturing processes and the performance of the end product
- Describe the manufacturing processes for ceramics, polymers, and composite materials especially as they relate to metal and alloy replacement applications

## Manufacturing Processes, Part 3

### Objectives:

- Identify and describe the general classifications of manufacturing systems that provide us with product
- Identify important processes used to manufacture parts from different materials, and select appropriate techniques to produce finished parts
- Understand and describe the fundamental cutting and forming processes used to make products or parts
- Understand and describe the basic technical aspects of new manufacturing processes for high-tech applications
- List the advantages and disadvantages of manufacturing methods used to process various materials and understand why each of these processes may be used in different applications
- Identify and describe the most important methods of joining components or subassemblies to make completed parts
- Understand and select appropriate finishing methods for manufactured parts
- Understand and describe the basic manufacturing systems used to assemble parts into finished products

## Manufacturing Processes, Part 4

### Objectives:

- Understand and describe the basic functions of management and the principles on which work is organized in a manufacturing business
- Understand and describe various types of production control systems
- Describe the basic concepts behind modern production systems
- Explain how modern QA systems affect the manufacturing processes and product and process quality
- Understand how modern network-based communications technologies will affect the manufacturing process now and in the future

## Trades Safety: Getting Started

### Objectives:

- List the physical hazards associated with chemicals and describe how to avoid them
- Name several electrical shock hazards and the techniques used to prevent shocks
- List the steps in a lockout/tagout procedure
- Explain the importance of machine guarding, and name several types of machine guards
- Name the five classes of fire and how to extinguish each of them
- Describe the proper technique used to manually lift a heavy load
- Explain how to avoid hand injuries when using hand and power tools
- List some of the hazards involved in welding and hot cutting operations and how to prevent them
- Explain how job analysis and ergonomics are used to improve the workplace
- Explain the importance of using personal protective equipment (PPE)
- Name the agencies and organizations that make and enforce safety

## Working Safely with Chemicals

### Objectives:

- Recognize the different ways in which a chemical can cause you physical injury
- Name the paths of entry along which chemicals enter your body
- Describe the basic types of injuries caused by chemicals
- Identify potential chemical hazards in the workplace
- Describe how to identify, store, and label hazardous chemicals
- List several methods used to prevent chemical accidents
- Explain why proper training is important to chemical handling
- Describe the types of personal protective equipment used when handling chemicals
- Explain the role of government agencies in enforcing chemical regulations

## Fire Safety

### Objectives:

- Describe the types of property losses and injuries associated with fires
- Explain how fires are ignited
- Identify the five classes of fire
- Describe the primary fire hazards found in the workplace
- Explain the various ways in which fires can be prevented
- Describe the operation of several different fixed fire protection systems
- Identify the proper type of portable fire extinguisher to use on a fire
- Describe the operation of several different types of fire extinguishers
- Explain how to defend yourself and others in a fire situation
- Describe how to evacuate a burning building in a safe manner

## Safe Handling of Pressurized Gases and Welding

### Objectives:

- Identify common welding gases and the hazards associated with each of them
- Safely handle and store different types of gas cylinders
- Recognize the safety considerations involved in the setup and operation of electric arc-welding equipment
- Explain how to safely set up and operate a basic gas welding rig
- Identify welding equipment malfunctions and take corrective action
- Utilize fire prevention and protection methods specific to welding operations
- Discuss the importance of the hot-work-permit program in your facility
- Explain the correct use of protective clothing and equipment for welding
- Understand the importance of proper ventilation when welding
- Describe how to effectively deal with confined spaces when performing welding operations

## Advanced Electrical Safety

### Objectives:

- Explain how electricity can harm you and property
- Discuss the importance of using quality electrical components
- Describe why it's important to properly ground electrical installations
- Understand the type of equipment used in hazardous locations
- List the safety practices required when performing electrical work
- Discuss the importance of workspace clearance around electrical enclosures

## Material-Handling Safety

### Objectives:

- Recognize the hazards associated with handling materials
- Know the types of injuries that can be caused by these hazards
- Understand how to effectively use safe material-handling practices
- Know how to avoid physical injury when handling loads
- Identify the parts of a powered lift truck and similar mechanized material-handling equipment
- Explain how to operate various types of mechanized material-handling equipment safely
- Know and follow the rules for safe operation of powered industrial material-handling equipment
- Understand and respect the limits and restrictions placed on powered material handling mechanisms

## Machine Safety

### Objectives:

- Recognize the basic machine motions that can present a hazard to you
- Recognize the types of machinery most likely to be hazardous to you
- Understand the types of injuries caused by accidents commonly associated with unsafe machine-operating procedures
- Discuss the importance of machine guarding and how to incorporate methods of guarding to avoid physical injury
- Recognize the types of machine guards commonly used in industry
- Control various forms of hazardous machine energy through the use of lockout/ tagout procedures
- Understand how and why to properly use personal protective equipment for added protection when operating industrial equipment

## Introduction to Print Reading

### Objectives:

- Identify the various kinds of lines used on drawings
- Compare and contrast the various types of drawings
- Relate the information given in the title block and bill of material to the drawing
- Define different types of scales used on drawings
- Identify the different views used on drawings

## Reading Shop Prints, Part 1

### Objectives:

- Properly interpret working drawings (including dimensions and tolerances)
- Interpret symbols, notes, and specification
- Identify material requirements
- Interpret drawings to determine the proper procedure to make the part

## Reading Shop Prints, Part 2

### Objectives:

- Read and properly interpret various shop prints
- Interpret and use cam prints
- Interpret and use gear prints
- Read and understand an assembly drawing and bill of materials
- Read simple sheet metal drawings

## Dimensioning

### Objectives:

- Identify the height, width, and length dimensions of a drawing
- Interpret dimensions on angles, arcs, fillets, rounds, holes, and chamfers
- Interpret the surface finish symbols for roughness, waviness, and lay

## Tolerancing and Symbols

### Objectives:

- Tell the position method from the bracket method of dual dimensioning
- Identify the three general classes of fit
- Interpret unilateral and bilateral tolerances
- Interpret the various symbols and notations used on drawings

## Sectional Views and Simplified Drafting

### Objectives:

- Tell one type of section from another
- Interpret the various types of sections
- Interpret drawings using simplified drafting methods

## Common Hand Tools, Part 1

### Objectives:

- Identify common hand tools and their function
- Explain how to safely use common hand tools
- Maintain most types of hand tools
- Describe the benefits of several special features available for some hand tools

## Common Hand Tools Part 2

### Objectives:

- Identify and use various chisels and punches safely
- Use and care for cutting tools
- Understand the need for specialized maintenance tools
- Correctly use threading and other precision tools

## Precision Measuring Instruments, Part 1

### Objectives:

- Explain the difference between accuracy and precision
- Define standard, the Rule of 10, and traceability
- Describe Abbe's error
- Describe how to use a number of tools for measuring dimensions
- Read a vernier scale
- Demonstrate the skill to work with both English and metric systems and with their abbreviations Convert between millimeters and inches

## Electric Drilling and Grinding Tools

### Objectives:

- Safely set up and operate a portable electric drill, drill press, and electric hammer
- Choose the proper drill bit for many drilling applications
- Select the proper drilling tool for an application
- Set up and use a variety of hand and bench grinders
- Safely use the proper grinder for various jobs
- Follow the necessary steps for proper tool maintenance

## Power Cutting Tools

### Objectives:

- Identify the most common portable and stationary power saws
- Identify the various parts of a saw and explain how they work
- Discuss the types of cuts made by each type of saw
- List the various safety precautions you should follow when using power saws
- Choose the most appropriate saw and blade for the type of work being done



## Pneumatic Tools

### Objectives:

- Describe the various pneumatic tools used for plant maintenance
- Identify and describe the safe use of impact, cutting, and grinding tools
- Explain how pneumatic hammers, nailers, and staplers are selected and used in a safe manner
- Describe the use of pneumatic assembly tools such as grinders, sanders, screwdrivers, and drills and how other types of production tools are selected and used
- Identify the proper procedures for pneumatic tool and system care
- List procedures for safely using pneumatic tools
- Understand how vibration and excess noise can cause bodily injury

## Plumbing and Pipe-Fitting Tools

### Objectives:

- Explain the importance of safety on the job
- Identify the rules of job safety and tool safety
- Apply the rules of job safety and tool safety to workplace situations
- Identify the various tools available to perform layout, cutting, and boring tasks
- Determine when and how to use layout, cutting, and boring tools
- Identify the tools available to join and assemble pipes of various materials
- Determine when and how to use pipe-joint assembly tools
- Identify the tools needed for testing and maintaining piping systems
- Determine when and how to use finishing, testing, and maintenance tools for piping systems

## Electricians' Tools

### Objectives:

- Explain how various hand tools are used by an electrician
- Discuss the safe use of hand tools and power tools
- Perform basic calculations and measurement conversions using the metric system
- Use Ohm's law to explain the relationship among current, voltage, and resistance in a circuit
- Explain how electrical measuring instruments are used to measure current, voltage, and resistance
- Define many of the basic electrical terms that electricians use every day
- Identify the basic symbols used in electrical schematic drawings

## Tool Grinding and Sharpening

### Objectives:

- Use a grinding machine, following all safety procedures
- Hone, or whet, tools with an oilstone
- Explain the procedures for grinding metal stock
- Compare the methods used in grinding screwdrivers, snips, chisels, plane irons, and twist drills

## Woodworking Hand Tools

### Objectives:

- Distinguish between the types of hand saws, and use them correctly
- Bore and drill holes wood
- Explain the differences between planes, and use planes effectively
- Use abrasive tools correctly

## Routers, Power Planers, and Sanders

### Objectives:

- Operate (with practice) the portable router
- Outline the procedures for using a portable power planer
- Recognize by sight the common stationary power sanders, and compare their operation
- Choose the right portable power sander for a given job, and operate (with practice) the portable belt sander

## Jacks, Hoists, and Pullers

### Objectives:

- Identify the many forms of jacks and hoists
- Safely operate jacks and hoists
- Understand the construction details of fiber ropes, wire ropes, and chains
- Properly use and maintain fiber-rope, wire-rope, and chain slings
- Properly use jaw and push pullers

## Lubrication, Part 1

### Objectives:

- Describe the various types of friction
- Discuss how materials wear
- List the various functions lubricants perform in industry
- Explain how lubricants reduce friction
- Classify lubricants depending upon their composition, properties, and additives
- Understand why certain lubricants are chosen for certain tasks
- Explain how to safely handle and store lubricants

## Lubrication, Part 2

### Objectives:

- Explain how to manually apply various types of lubricants in an industrial environment
- Describe total-loss lubrication
- Identify a nonloss lubrication system's components and describe their operation
- Explain how to maintain a nonloss lubrication system
- Identify the proper lubrication procedures to use for special industrial applications including sealed bearings, oil-impregnated bearings, and food-processing plants
- Explain how lubricant-conditioning systems work and how to maintain them
- Describe how automatic lubrication systems work and how to maintain them
- List the tasks involved in preventive and predictive lubrication maintenance

## Precision Measuring Instruments, Part 2

### Objectives:

- Properly read standard and metric micrometers
- Read a vernier micrometer
- Choose special micrometers appropriately for various measuring tasks
- Recognize five kinds of depth and height gages and demonstrate the ability to read a depth gage
- Read the scale on a vernier bevel protractor
- Explain the uses of many kinds of indicators and gages in shopwork
- Describe how to minimize cosine error when using dial test indicators

## Precision Measuring Instruments, Part 3

### Objectives:

- Explain the use of optical comparators and toolmaker's microscopes
- Recognize the setup and operation of an optical alignment system—including laser and alignment telescopes
- Understand the use of digital readout gauges, and the use of both absolute and incremental measuring
- Recognize the uses for in-process and post-process gauging, including video inspection and CNC tool presetters
- Understand the use of hardness testers and video material testing
- Recognize the uses for modern nondestructive material testing, including magnetic particle inspection and ultrasonic testing

## Drilling, Part 1

### Objectives:

- Recognize and use basic drilling equipment and components
- Identify and use various types of drill tools
- Explain how to set up various workpieces on a drill press
- Understand how to recondition drilling tools and maintain equipment

## Drilling, Part 2

### Objectives:

- Explain how to set up more complex drilling equipment
- Select and use various types of auxiliary tools with drill equipment
- Set up more advanced work on a drill press
- Select and modify drills for different materials and cutting conditions
- Determine the correct speeds, feeds, and coolant for a given operation
- Diagnose quality, tolerance, and tool-life problems, and find solutions for them

## Metal Processing

### Objectives:

- Identify industrial metals by their names and chemical symbols
- Define in basic terms the characteristics and properties of metals
- Explain the various metal-processing methods used in producing industrial metals
- Explain how metals are extracted from their ores found in the earth and then refined

## Ferrous Metals

### Objectives:

- Identify the features of a blast furnace
- Recognize cast irons by their fractures and other properties
- Describe the major steelmaking processes
- Discuss the hot-working and cold-working methods used to shape steel
- Classify the types of steel, according to both processing method and carbon content
- Relate certain grade numbers to the types of steel they identify

## Nonferrous Metals

### Objectives:

- Explain how the various metals are extracted from their ores
- Describe how the addition of certain elements affects the mechanical properties of the base metals
- Select the metal alloy most suitable for a given job
- Recognize whether a copper alloy is a brass or a bronze

## Identification of Metals

### Objectives:

- Identify a metal by making a file test, magnetic test, temperature test, chip test, or spark test
- Find the hardness of a metal, by using a Brinell, Rockwell, monotron, Vickers, Herbert-pendulum, or scleroscope hardness-testing machine

## Fasteners

### Objectives:

- Describe the various types of fasteners
- Identify the different types of thread form systems
- Recognize various nonthreaded fasteners and discuss their uses
- Explain how to install and uninstall fasteners
- Understand the terminology used in measuring fasteners
- Explain how adhesives are used as fasteners

## Bearings and Seals, Part 1

### Objectives:

- Understand what friction is and how bearings help reduce it
- Explain the difference between plain and antifriction bearings
- List the different types of plain bearings
- Understand the characteristics of plain bearings
- Recognize the importance of proper handling, installation, and lubrication of plain bearings
- List different materials used to make plain bearings and how material type affects their use
- Explain how to prevent premature failure of plain bearings

## Bearings and Seals Part 2

### Objectives:

- Identify the various parts of an antifriction bearing
- Identify the various parts of a seal
- Choose the proper seal for a given application
- Explain the importance of providing bearings with a sufficient supply of the proper lubricant and the result of failing to do so
- Differentiate between the features and capabilities of the different types of antifriction bearings
- Identify common problems that occur in antifriction bearings and suggest potential solutions

## Introduction to Pumps and Compressors

### Objectives:

- Recognize the parts of the three basic types of pumps
- Understand the working of different types of pumps
- Select the proper pump for a specific use
- Know why air compressors are used in plants
- Describe the parts of air compressors
- Select the proper air compressor for a specific use

## Introduction to Power Transmission

### Objectives:

- Install, inspect, and troubleshoot V-belt drives
- Understand the construction details of various types of belts and sheaves
- Identify the components (parts) and uses of various chains
- Select the suitable oil for lubricating chain drives
- Describe the various types of gears used for transmitting power
- Properly lubricate open and closed gear drives