

CAD/Drafting Basics

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

The 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
- Remove parentheses from an expression and simplify the expression

Linear Distance and Measurement

Objectives:

- Measure using both English and metric (SI) 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.

Algebra: Monomials and Polynomials

Objectives:

- Remove grouping symbols from algebraic expressions, dividing by a monomial when indicated
- Multiply binomials by monomials, trinomials and other binomials
- Calculate the square root and the third power of given monomials
- Find special products involving binomials
- Divide one polynomial by another polynomial of lower degree

Algebra: Factoring

Objectives:

- Find the prime factors of certain binomials and trinomials
- Factor a given trinomial
- Use the Factor Theorem to factor a given polynomial
- Use factoring to find the roots of an equation
- Divide one polynomial by another polynomial of lower degree

Algebra: Addition and Subtraction of Fractions

Objectives:

- Identify electric circuits in terms of their characteristics
- List several circuit characteristics used to describe a circuit for a particular load application
- Identify electrical components wired as series and parallel circuits
- Describe how to control loads from one or two switch locations
- Describe how current flows in a three-wire circuit
- Describe how current flows in delta-and wye-connected circuits
- Calculate the line-to-line and line-to-neutral voltage in a Y-connected circuit

Algebra: Multiplication and Division of Fractions

Objectives:

- Recognize equivalent algebraic fractions
- Perform additions and subtractions involving algebraic fractions
- Find the least common denominator for a group of algebraic fractions
- Reduce an algebraic fraction to its lowest terms

Applied Geometry

Objectives:

- Identify properties and types of angles and figures
- Distinguish between common geometric solids
- Use the Pythagorean theorem to solve triangles
- Calculate the perimeter and area of polygons, circles, and ellipses
- Determine the surface area and volume of commonly encountered geometric solids

Practical Trigonometry

Objectives:

- Define and compute the value of trigonometric functions such as cosine, sine, tangent, and others
- Use trigonometric functions to find the lengths of sides and angles in right and oblique triangles
- Understand trigonometric functions as they relate to waves
- Solve practical problems using trigonometry

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 notation 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

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 regulations, and explain an employee's responsibilities under those regulations

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

Elements of Print Reading Part 1

Objectives:

- Given a drawing, interpret the dimensions and notes
- Differentiate between perspective, isometric, orthographic, and working drawings
- Identify the classifications of fits and the use of tolerances and their method of application
- Shown a scale for a drawing, be able to convert the sizes
- Identify the symbols used to indicate the surface finishes

Elements of Print Reading Part 2

Objectives:

- Distinguish between simplified and section drawings.
- Interpret the symbols used in section drawings.
- Given a drawing, identify the different components and interpret dimensions and notes.
- Calculate the taper on a given workpiece.
- Point out the differences between the types of rivet symbols used on a working drawing.
- Choose the proper information on a drawing to calculate a dimension that is not indicated.

Geometrical Drawing Part 1

Objectives:

- Identify key terms and illustrations of geometrical terms as they apply to drawing work
- Recognize and use drawing instruments used in drafting
- Perform exercises to improve skills of lettering and numbering used in drafting

Geometrical Drawing Part 2

Objectives:

- Understand the purpose of drawing plates and their general features
- Identify the kinds of lines used on plates and the kinds of geometrical problems drawing will solve
- Recognize solutions and general information about Plates 401-1, 402-1, 403-1, 404-1, and 405-1

Elements of Projection Drawing

Objectives:

- Identify the uses and features of Orthographic Projection
- Make four drawing plates: Projections of Simple Solids; Foreshortened views in Projection; Section of Cones and Cylinders; Intersections and Developments
- Identify the principles of isometric, oblique, and cabinet projection
- Make an acceptable patent drawing using industry best practices
- Understand isometric, dimetric, and trimetric projection and how the axes can be foreshortened

Machine Sketching

Objectives:

- Describe different sketching materials
- Identify the uses for different kinds of sketches
- Recognize the instruments used to take measurements for sketches
- Understand multiple methods for making isometric, oblique, and pictorial sketches.

Principles of Mechanics Part 1

Objectives:

- Identify the scope of the study of mechanics
- Define the forms of energy and the physical properties of bodies
- Explain the motion of bodies
- Define the terms acceleration, retardation, and mass and weight
- Explain the center of gravity, and the effect of work and energy
- Apply the principles of mechanical advantage and the coordinate of systems
- Describe computation, measurements, and Newton's Laws of Motion
- Apply the principles of uniform motion
- Calculate problems using graphic and analytic methods
- Describe the concepts of variable motion and falling bodies
- Identify the nature of simple harmonic motion
- Describe the nature of centrifugal force

Principles of Mechanics Part 2

Objectives:

- Explain concurrent and parallel forces
- Identify the nature of friction and sliding friction
- Apply machine elements such as levers
- Identify the advantages of levers and actions of an inclined plane
- Explain wedges and screw threads
- Describe the general principles of wheels, axles, and tackle
- Calculate friction in a tackle and differential chain hoist
- Define the functions of pulleys, belts, and gears
- Explain spur, bevel, and helical gears
- Describe worm and skew gears and sprockets
- Identify gear trains and change gears
- Explain belts, chains, and keys

Elementary Mechanical Drawing

Objectives:

- Identify different kinds of equipment for and components of drawing
- Use various styles and types of lettering
- Identify kinds of lines used on plates and different plate numbers, as well as general features of drawing plates
- Understand the details of Plates 721-1, 722-1, 723-1, 724-1, 725-1, 726-1, 727-1, 728-1
- Designate welds on drawings

Mechanical Drawing

Objectives:

- Familiarize yourself with conventional methods used in drawing
- Identify the properties of drawing plates
- Define and incorporate surface roughness, waviness, and lay
- Use plates 931, 932, 933, 934, 935, 936,
- Differentiate among different types of screw threads and be able to draw them
- Define true position and maximum material condition
- Follow rules for neat, accurate drawing

Physics Part 1

Objectives:

- Describe the fundamental concepts of physics
- Define the nature of motion
- Calculate vectors and forces
- Explain the properties of fluids and gases
- Explain work, energy, and power
- Identify machine elements
- Explain the principles of gears
- Describe nuclear energy

Physics Part 2

Objectives:

- Describe the part that heat and temperature play in the study of physics
- Explain sound and ultrasonics
- Explain the properties of light
- Define electricity and magnetism
- Explain electromagnetic motor action
- Explain Ohm's Law and circuits
- Explain electric power and electronics
- Describe radio communications

Sheet Metal Drafting Part 1

Objectives:

- Identify sheet metal products and occupations
- Use tools, measuring instruments, shortcuts, and other practical sheet metal drafting tools and methods
- Differentiate among sheet metals and fastenings by type, gage, and allowance
- Recognize common seams, locks, and edges
- Understand common terms and practices in sheet metal shops
- Cut relief radii, calculate bend allowances, and piece together large fittings
- Discuss polyvinyl chloride, vinyl-metal laminate, and Dupont's polyvinyl fluoride

Sheet Metal Drafting Part 2

Objectives:

- Define straight, transition, and s-type offset ducts
- Use plates 451 and 452
- Identify square-throat and radius-throat elbows

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 dimensions and with their abbreviations
- Convert between millimeters and inches

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

Advanced Mechanical Drawing Part 1

Objectives:

- Make eight mechanical drawing plates: helical forms, gear-teeth profiles, gear and pinion, bevel and worm gearing, plate girder, blowoff cock and rigging, iron casting, and automobile piston
- Define tolerance dimensions and record changes and indicate them on drawings
- Create auxiliary views

Advanced Mechanical Drawing Part 2

Objectives:

- Be able to make nine drawing plates: machine component, bench vise details, bench vise assembly, pump casting, pump details and assembly, details of a bearing, assembly and details of a housing, sliding bracket, and pillow block.
- Produce blueprints with a machine and understand the Ozalid process

Mechanical Testing of Materials, Part 1

Objectives:

- Define the physical properties of materials
- Identify mechanical testing machines
- Describe the tension test and compression test

Mechanical Testing of Materials, Part 2

Objectives:

- Perform transverse of beam tests and shear and torsion tests
- Understand how to do hardness and impact testing
- Perform miscellaneous tests for ductile materials
- Test nonmetals

Mechanical Power Transmission, Part 1

Objectives:

- Explain the physical principles that govern mechanical power transmissions
- Identify and name the type of shaft misalignment present in a given application, and select the type of coupling that compensates for it
- Name the major components of any coupling and state their functions
- Describe the major difference between a resilient coupling and an all-metal coupling
- Identify the major components in a belt-drive system
- Explain the operating principles of flat-belt, V-belt, and positive-belt type drives
- Name the major operating advantages of each type of belt drive, and show how to compute the speed ratio of a belt drive
- State the main steps in installing various types of belt drives
- Select the proper solution for a problem with an operating belt drive

Mechanical Power Transmission, Part 2

Objectives:

- Identify different gear types and explain their unique operating characteristics
- Describe how to mount and remove a gear from its shaft
- Explain the main gear dimensions
- Interpret gear and gearbox ratings
- List the general types of gearboxes and explain the kind of applications for which each is best suited
- Describe how gearboxes are lubricated and explain how lubricants are selected and tested

Mechanical Power Transmission, Part 3

Objectives:

- Identify different chain drive configurations and explain their unique operating characteristics
- Describe the general procedure for installing coupling links and maintaining and checking chain tension
- Interpret chain drive system ratings
- Describe the different ways in which chain drive systems are lubricated
- Understand the rating system for brakes and clutches
- Identify the different types of brake and clutch systems, and the applications each type is suited for
- Explain the considerations in selecting a specific multimedia drive
- Describe the predictive-maintenance techniques used on mechanical power transmission systems, and the analysis of power transmission problems