

Welding

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
- 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

Trades Safety: Getting Started

Objectives:

- Name the agencies and organizations that make and enforce safety regulations, and explain an employee's responsibilities under those regulations
- List the physical hazards associated with chemicals and describe how to avoid those hazards
- Name several electrical shock hazards and the techniques used to prevent shocks
- List the steps in a lock out and tag procedure
- Explain the importance of machine guarding, and name several types of machine guards
- Name the four classes of fire and how to extinguish each of them
- Describe the proper technique used to lift a heavy load
- Explain how to avoid hand injuries when using hand tools 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 the science of ergonomics are used to improve the workplace
- Explain the importance of using personal protective equipment (PPE) and name several types of PPE

Working Safely with Chemicals

Objectives:

- Recognize the six different ways in which a chemical can cause you physical injury
- Name the routes or paths of entry by which chemicals can enter the body
- Describe the basic types of injuries caused by chemicals
- Identify potential chemical dangers in your 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 and worn when handling chemicals
- Explain the role of governmental 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 four 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 safely evacuate a burning building

Safe Handling of Pressurized Gases and Welding

Objectives:

- Identify common welding gases and understand how they're used in welding operations
- Point out the hazards associated with welding gases
- Safely handle and store different types of gas cylinders
- Safely operate a basic gas welding setup
- Recognize the safety considerations involved in the setup and operation of electric arc-welding equipment
- 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
- Utilize proper ventilation when welding
- Effectively deal with confined spaces when performing welding operations

Electrical Safety

Objectives:

- Explain how electricity can harm you and your property
- Discuss the importance of properly using quality electrical components
- Follow the basic methods of protection when wiring electrical installations
- Tell why it's important to ground electrical equipment and systems
- Select the type of electrical equipment to use in a hazardous location
- List the safety practices required in an electrical work area
- Talk about the importance of a clear working space around electrical equipment
- Educate your own level of safety training to be sure it matches the electrical work you're performing

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
- 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 four basic 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 using industrial equipment

Jobs, Companies, and the Economy—Basic Concepts for the Employee

Objectives:

- Conclude how the economy will affect you as a consumer and as an employee
- Explain the concept of competition and how a business must react to market demands
- Evaluate how government policies affect the amount of saving and investing within an economy
- Defend the use of a flexible and empowered workforce in making a business more competitive
- Explain various economic measuring tools such as the inflation rate, the unemployment rate, and the GDP
- Appraise the current status of American labor in general and the status of American labor unions in particular
- Recognize how you as an employee or as an employer must compete in an increasingly international marketplace

Quality Concepts: Terminology

Objectives:

- Define quality and total quality management, using examples
- Describe how quality has evolved to where it is today
- Explain several motivations for quality improvement
- Describe how quality-conscious organizations have changed for the better
- Assess quality-consciousness in individuals and organizations
- Explain how some familiar business practices have led to TQM and how certain other common practices have gotten in the way of TQM
- Name some successful results of TQM programs

Introduction to Print Reading

Objectives:

- Describe the basic format for conveying technical information in a drawing
- Identify and interpret the various drawing views used in technical drawings
- Understand how information is organized in notes and title blocks
- Interpret the different line types used in drawings
- Understand the concept of the drawing scale and how it affects information shown in the drawing

Print-Reading Symbols and Abbreviations

Objectives:

- Interpret the most common abbreviations used on drawings
- Understand and interpret the various symbols and notations used on drawings for electrical, architectural, mechanical, and other types of applications
- Recognize how symbols are used to show standard materials, parts, and assemblies
- Interpret thread specifications
- Understand some common symbols used in machining prints
- Recognize common symbols found on hydraulic and pneumatic prints

Dimensioning and Tolerancing

Objectives:

- Know the international standards and conventions that apply to drawings
- Understand how different numbering systems were developed and how they're applied to prints and drawings
- Understand dimensions and tolerances on drawings that describe geometries of parts and assemblies
- Recognize and interpret common symbols and nomenclature used in geometric dimensioning and tolerancing (GD&T)
- Understand how GD&T uses symbols to explain and describe the designer's intent, and eliminate misinterpretation of the print

Print Reading Applications

Objectives:

- Understand standard drawing formats that give information about part titles, part numbers, dimensional standards, revisions, and materials
- Explain how various components shown on prints are connected or related to each other
- Obtain important information from a drawing about quantities, materials, assembly processes, or dimensions
- Visualize the three-dimensional parts and assemblies represented by two-dimensional drawings

Building Drawings

Objectives:

- Identify the various kinds of building drawings
- Compare elevations, plans, and sections
- Match the symbols used on drawings with the various building materials they stand for
- Interpret the explanations and abbreviations used on building drawings
- Read steel and concrete structural drawings

Electrical Drawings and Circuits

Objectives:

- Identify electrical construction drawings, schematics, and wiring diagrams
- Interpret various electrical symbols
- Read standard abbreviations used in electrical diagrams
- Tell if a diagram is a block diagram, a schematic diagram, or a wiring diagram
- Compare closed circuits, open circuits, grounded circuits, and short circuits

Electronic Drawings

Objectives:

- Identify and interpret the various electronics symbols used on drawings
- Identify and interpret the various types of drawings used in the electronics field

Hydraulic and Pneumatic Drawings

Objectives:

- Identify and interpret graphic symbols for lines, flows, and reservoir
- Identify and interpret pump and valve symbols
- Identify and interpret fluid circuit and air circuit components
- Identify and interpret graphical, circuit, cutaway, pictorial, and combined diagrams

Piping: Drawings, Materials, and Parts

Objectives:

- Define the term "piping drawings"
- Recognize on sight plans, elevations, and sectional views
- Identify a view by its placement on a drawing
- List what working drawings include
- Evaluate whether or not a freehand sketch serves its intended purpose
- Interpret the standard symbols and abbreviations used on piping drawings and diagrams
- "Read" the color coding on piping in industrial and power plants
- Interpret dimensions marked on piping drawings
- Define piping plans, diagrams, plot plans, general arrangements, and details, and state the use of each
- List the various materials used for pipe and give the characteristics of pipe of each material
- Classify pipe by material, construction, end condition, strength, and size
- Recognize the various types of valves and identify their use and construction
- List and identify various kinds of pipe hangers and supports and other piping accessories

Welding Symbols

Objectives:

- Identify by name the welding processes commonly used in plant maintenance work
- Name the best welding processes for a given welding job
- Identify by sight the basic joint and groove designs used in welding
- Identify by sight the basic types of welds, and describe their uses
- Interpret the weld symbols most often found in the drawings used in plant maintenance work

Sheet Metal Basics

Objectives:

- Identify sheet metal of known material and thickness by gage and weight
- Figure allowances for bends, circumferences, seams, locks, and edges
- Know when and where to cut relief radii
- Catalog and identify by sight the various seams, locks, and edges
- Name and describe the major tools and machines used in sheet metal working
- Explain how large fittings can be constructed
- List the characteristics of PVC and PVF sheet and laminates

Sketching

Objectives:

- Use the right techniques for sketching straight and curved lines, and circles and arcs
- Make, with practice, multiview sketches of simple objects that accurately show all the details of the objects
- Dimension sketches of simple machine parts with enough detail that parts can be made
- Draw, with practice, realistic picturelike sketches of objects that have simple rectangular and circular shapes

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

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

Bench Work, Part 1

Objectives:

- Define bench work
- List the types of operations and tools used in bench work
- Describe how to use tools for making holes, for cutting operations, and for finishing and grinding
- Discuss how to care for tools to keep them in good working order

Bench Work, Part 2

Objectives:

- Identify common types of threaded fasteners by their physical characteristics
- Choose a suitable fastener for a given application
- Explain the function of POP rivets
- Calculate the pitch of a screw
- Read and interpret standard thread identifications
- Select the proper tool for a spot-facing operation
- Estimate the number of tinner rivets in a given weight
- Identify specific details of single-riveted and double-riveted joints
- Explain the function of a feather key
- Select a suitable tap for a given application
- Choose a proper cutting fluid for tapping on specific material
- Explain why crowding should be avoided in tapping
- Select the proper tap wrench for use with small taps
- Choose a suitable tool for removing a broken fastener from a threaded hole

Bench Work, Part 3

Objectives:

- Calculate the unilateral tolerance when the dimensions of a part are given
- Given the dimensions of a shaft and bore, calculate the allowance
- Select the accessories needed for rebabbitting a solid bearing
- Given a saw blade, distinguish the different parts
- Given examples, identify the proper method of clamping a work for sawing
- Tell what dimension of a vertical band saw establishes the saw's rated capacity
- Identify a part produced by a vertical band saw machine
- Select a band saw with a width suitable for cutting a given radius on a workpiece
- Calculate the length of the saw blade required to make a band saw for a given vertical band saw machine
- Explain the need for tinning a soldering copper
- Select the proper flux for brazing operations

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

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:

- 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

Algebra: Multiplication and Division of Fractions

Objectives:

- Perform multiplications and divisions involving algebraic fractions
- Solve Equations involving fractions or decimals
- Simplify complex fractions

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

Fundamentals of Welding, Part 1

Objectives:

- Recognize the various welding positions
- Describe the types of welds, electrodes, and current settings typically used in these positions
- Identify the appropriate procedures for welding heavy metal plates
- Identify the appropriate joint designs and joint dimensions used when welding sheet metal

Fundamentals of Welding, Part 2

Objectives:

- Recognize the basic joint designs used in welding
- Explain the various positions used in welding
- Distinguish between different types of welded joints
- Interpret the welding symbols that convey instructions from the designer to the welder

Practical Metallurgy for Welders, Part 1

Objectives:

- Identify metals used in welding
- Describe testing procedures, including hardness, temperature, and magnetism, for a variety of metals
- List the physical, chemical, and mechanical properties of various metals

Practical Metallurgy for Welders, Part 2

Objectives:

- Identify electrodes used in welding operations
- Identify rods and wires used in welding operations
- Explain the effect of welding heat on metals and how heat transfer, radiation, conduction, and convection occur
- Discuss standard joint designs, weld sequences, and welding jigs
- Describe metal grains and grain characteristics
- Identify the various types of iron and steel, aluminum and its alloys, copper and its alloys, and nickel

Gas-Welding Equipment, Part 1

Objectives:

- Describe the sources and properties of gases and calculate volume usage
- Evaluate the various gas-welding processes
- Distinguish between particular types of cylinders, hoses, and torches
- Identify the different valves and regulators used in welding equipment
- Select proper safety and maintenance procedures

Gas-Welding Equipment, Part 2

Objectives:

- Calculate the volume of acetylene used during welding, given the volume of oxygen used, and vice versa
- Explain the correct procedure for adjusting an oxyacetylene flame
- Describe the procedures for setting up and taking down an oxyacetylene-welding outfit
- Compare the types and heat outputs of various gas-welding flames
- Identify the various components of portable and stationary oxyacetylene-welding equipment
- Explain how to test an oxyacetylene system for leaks
- Discuss particular terms that pertain to the properties of gases used in welding
- Explain the operation of an acetylene generator

Gas-Welding Techniques, Part 1

Objectives:

- Review welding techniques, joint preparation, and weld testing
- Describe how to make practice welds in steel sheet, including corner, butt, lap and T joints; and fillet welds
- Discuss welds and testing on light sections of steel plate
- Discuss welding heavy sections of steel plate with multiple layers of weld metal

Gas-Welding Techniques, Part 2

Objectives:

- Explain techniques for welding steel and wrought-iron pipe
- List braze welding filler metals, fluxes, and joint preparations
- Discuss braze welding techniques for sheet metals, heavy steel, and dissimilar metals
- Distinguish welding techniques used for cast iron and malleable iron

Gas-Welding Techniques, Part 3

Objectives:

- Choose the proper oxyacetylene welding procedure for carbon alloy and stainless steels
- Distinguish oxyacetylene welding techniques and materials used for copper, aluminum, magnesium, nickel, and their alloys
- Describe precautions to take when welding lead, including the need to avoid fumes
- Discuss distortion during welding and how to control it

Common Thermal Cutting Processes

Objectives:

- Identify the uses of various thermal cutting processes
- Use tables to estimate requirements for particular cutting operations
- Describe various types of equipment used for oxyfuel gas cutting
- Identify the appropriate procedures used in various oxygen cutting processes

The Nature of Electricity

Objectives:

- Explain the operation of a simple circuit
- Define the terms conductor, insulator, and resistor
- Demonstrate that unlike charges attract and like charges repel
- List some of the dangers and benefits of static electricity
- Define the terms volt, ampere, and ohm
- Describe some common notations and prefixes used to identify electrical and electronic values
- Identify carbon resistors, potentiometers, rheostats, and relays, and explain how they work
- Identify some of the electrical symbols used in schematic diagrams
- Explain the difference between a series and a parallel circuit

Circuit Analysis and Ohm's Law

Objectives:

- Find the total resistance in series, parallel, and series-parallel circuits
- Use Ohm's law to calculate the amount of current, voltage, or resistance in circuits
- Calculate the amount of power supplied and dissipated in a DC circuit
- List the steps for reading current, voltage, and resistance with a meter

Capacitors and Inductors

Objectives:

- Explain how a capacitor holds a charge
- Describe common types of capacitors
- Identify capacitor ratings
- Calculate the total capacitance of a circuit containing capacitors connected in series or in parallel
- Calculate the time constant of a resistance-capacitance (RC) circuit
- Explain how inductors are constructed and describe their rating system
- Describe how an inductor can regulate the flow of current in a DC circuit
- Calculate the total inductance of a circuit containing inductors connected in series or parallel
- Calculate the time constant of a resistance-inductance (RL) circuit

Magnetism and Electromagnetism

Objectives:

- Identify the north and south poles of permanent magnets and electromagnets
- List several magnetic and nonmagnetic materials
- Describe how to magnetize a piece of steel by induction
- Explain the difference between simple, compound, and closed magnetic circuits
- Determine the direction of magnetic lines of force around a conductor (if the direction of the current is known)
- Use the right-hand rule to locate the poles of a solenoid
- Describe the operation of simple electromagnetic relays, buzzers, and stepping switches
- Explain how a DC motor operates
- Explain the generator action and motor action of electromagnetic induction in simple terms

Conductors, Insulators, and Batteries

Objectives:

- Describe the various types of conductors and discuss their conductivity
- Explain the American Wire Gage system of sizing copper conductors
- Determine the size of conductor needed for an application
- Identify the various types of insulating materials and list their temperature ratings
- Explain the difference between a dry cell and a storage battery
- Connect cells together to obtain more voltage, more current, or more of both voltage and current
- Describe the proper safety precautions used when working with storage batteries
- Describe how to properly clean and care for storage batteries
- Discuss the instruments used for testing storage batteries
- Explain how NiCad, lithium, and other types of special batteries operate, and describe their ratings

DC Motor and Generator Theory

Objectives:

- Describe the function of a commutator and brush assembly in a DC motor
- Explain how permanent magnet DC motors and stepper motors operate
- Identify series-wound, shunt-wound, and compound-wound motors and discuss their applications
- List the steps used to reverse a DC motor's direction
- Describe how the speed of a DC motor is controlled
- Explain the basic principle used to generate direct current
- List the factors that affect the strength of an induced voltage
- Explain how the field connections of series-wound, shunt-wound, and compound-wound generators differ
- Explain why it's necessary to shift brushes in a DC generator
- Discuss how interpoles and compensating windings can produce better generator operation
- List the various types of machine losses and calculate machine efficiency

Alternating Current

Objectives:

- Draw a graph of an AC voltage and describe how AC voltage is created
- Explain what an AC cycle is using the terms alternation, peak, positive, and negative
- Express the time period of an AC cycle in degrees
- List the characteristic values of an AC cycle and describe the relationship between the values
- Define phase angle and describe how it relates to reactive circuits
- Calculate power for single-phase and three-phase circuits
- Describe how a 220 VAC, single-phase circuit operates
- Calculate the phase and line voltages of multiphase wave forms
- Determine real power by reading a power factor meter
- Describe delta-connected and wye-connected three-phase circuit connections

Alternating Current Circuits

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 wye-connected circuit

Inductors in AC Circuits

Objectives:

- Explain how an inductor is made and how it operates in DC and AC circuits
- Define inductive reactance and impedance
- Describe how AC frequency affects impedance
- Apply Ohm's law when calculating the current in an AC circuit that includes an inductor
- Calculate the impedance of a series RL circuit
- Calculate the impedance of a parallel RL circuit

Capacitors in AC Circuits

Objectives:

- Describe how a capacitor stores a charge and how series-connected and parallel-connected capacitance values are calculated
- Define capacitive reactance
- Apply Ohm's law in AC circuits that contain a capacitor
- Calculate the impedance of a series RC circuit
- Calculate the impedance of a parallel RC circuit
- Explain how changing the frequency of an AC signal changes capacitive reactance
- Calculate the resonant frequency of an RCL circuit

Transformers

Objectives:

- Explain what the main parts of a transformer are
- Explain how mutual inductance makes it possible to change an AC (alternating current) voltage or current from one value to another
- Determine the turns ratio when the primary and secondary voltages or currents are known
- Calculate primary or secondary voltage or current when either one of these and the turns ratio are known
- Explain why transformer cores are laminated (layered)
- Connect three single-phase transformers for three-phase operation
- Calculate line current (if phase current is known) in delta-connected transformers
- Explain the principle of operation of an autotransformer

Alternators

Objectives:

- Explain how single and three-phase alternators operate
- List and describe the major parts of an alternator
- Discuss alternator ratings in terms of power, voltage, speed, and temperature
- State the steps required for starting, stopping, and operating alternators
- Describe the similarities and differences among the three main types of alternators

Electrical Energy Distributors

Objectives:

- Explain the difference between feeder and branch circuits
- Describe the different types of systems for distributing power within a plant
- Identify utilization equipment by name and look
- Discuss the use of transformers
- Identify names and uses of various types of raceways
- Distinguish between panel boards and switchboards
- Discuss the electrical system of a power utility
- Describe how electricity is generated

Rectification and Basic Electronic Devices

Objectives:

- Explain how diodes are manufactured
- Explain how diodes are used as rectifiers
- Identify the correct PN junction connection for forward and reverse bias
- Describe the characteristics of different diode types
- Interpret diode specifications as they would appear on a data sheet
- Explain the operation of SCRs and TRIACs
- Identify how single-phase and polyphase rectifiers operate
- Compare rectifier outputs with and without filter components

Arc Welding Equipment, Part 1

Objectives:

- Select the appropriate terminology used in arc welding
- Distinguish between AC and DC power sources used in arc welding and identify the basic components of their circuits
- Explain how to properly install an arc welding power source
- Describe the various types of equipment used in arc welding applications
- Explain how to operate, control, and maintain welding machines and identify their capacities and performance characteristics
- Explain the principles and applications of transformers
- Identify the characteristics, controls, ratings, capacities, and methods of operating transformer-type equipment

Arc Welding Equipment, Part 2

Objectives:

- Recognize and explain the uses for welding safety and supplemental equipment
- Distinguish a rectifier power source from one with direct current input
- Describe the various types of rectifiers, their construction, and their function
- Explain the use of alternating current in special welding applications
- Identify appropriate welding cable sizes and methods of cable connections
- Identify different types and sizes of electrode holders used and the ground connections made

Arc Welding Equipment, Part 3

Objectives:

- Distinguish the applications of various common welding processes in terms of required equipment
- Recognize the special control equipment typically used with a specific welding process
- Describe the electrode holders and other equipment needed for distinct welding operations at various degrees of automation
- Identify the different forms of shielding and equipment used in special welding procedures and processes

Shielded Metal Arc Welding Techniques, Part 1

Objectives:

- Identify safe welding practices
- Use tables to select electrode classifications and minimum lens-shade protection
- Distinguish between methods of striking an arc
- Describe how to make acceptable weld beads and surfacing welds
- Recognize weld defects and their causes

Shielded Metal Arc Welding Techniques, Part 2

Objectives:

- Recognize the various welding positions
- Describe the types of welds, electrodes, and current settings typically used in these positions
- Explain how to deposit a fillet weld in joints with a variety of edge preparations
- Identify the appropriate procedures for welding heavy metal plates
- Identify the appropriate joint designs and joint dimensions used when welding sheet metal

Gas Metal Arc Welding (GMAW)

Objectives:

- Identify the several variables involved in gas metal arc welding, and recognize how they can all be controlled to obtain the desired results in a welding operation
- Identify the equipment and supplies required for different GMAW applications, and explain how to properly set up, use, and care for this equipment
- Explain how to prepare workpieces for gas metal arc welding
- Select the correct welding gun positions and manual techniques appropriate for various GMAW operations
- Identify the problems most likely to be encountered during welding, and explain how such problems could be corrected

Arc Welding of Low Carbon Steel, Part 1

Objectives:

- Identify and classify the types of steel based on composition and casting operations
- Given the AWS classification system, identify particular arc welding electrodes and their composition
- Calculate the amount of filler wire needed for submerged-arc and electroslag welding methods, and select their correct operating conditions and functions
- Given different types of electrodes, pick the ones needed to weld each of the various low-carbon steel joints
- Describe how weld metal is tested and the way the weld specimens are made
- Identify the items required for qualified welding procedures and discuss when and how they are used

Arc Welding of Low Carbon Steel, Part 2

Objectives:

- Identify Mig electrodes and their composition according to the AWS classification system
- Choose the proper arc shielding gas, based on use and effect required
- Explain and distinguish between the operating conditions and uses of Tig, Mig, and pulse-spray welding
- Select the appropriate type of electrode and operating conditions for various gas-shielded welding applications
- Calculate weld time, amount of weld deposit, and wire speed, by the use of charts and tables

Arc Welding of Alloy Steels and Iron

Objectives:

- Discuss arc welding of alloy steels, including the electrodes required
- Differentiate the arc welding techniques used for different types of cast iron
- Explain how to cut metal with a carbon arc
- Identify the properties of types of steel and how those properties affect welding operations

Arc Welding of Non-ferrous Metals and Overlaying

Objectives:

- Describe how to weld non-ferrous metals
- Define and explain the process of overlaying
- Describe carbon-arc and metallic-arc cutting

Fundamentals of Metal Cutting

Objectives:

- Describe the metal cutting process and cutting tool requirements
- Describe carbon and carbide cutting tools
- Describe the principles of single-point cutting tools and factors of tool wear
- Explain multiple-point cutting tools and their uses
- Identify parts of drills and drilling speeds and feeds
- Describe tapping, threading, and reaming

Basic Test Equipment

Objectives:

- Identify the schematic symbols used to represent various reactive devices
- Define the terms voltage, current, and resistance, and explain their relationship in a circuit
- Discuss how voltage, current, and resistance is measured with a multimeter
- Describe the major features of analog and digital VOMs
- Explain how to use both analog and digital VOMs to measure voltage, resistance, and current in a circuit
- Discuss some of the important safety precautions you must take when using a multimeter

Troubleshooting with Volt-Ohm-Milliamp Meters

Objectives:

- List the safe practices you should use when troubleshooting with a VOM
- Describe the purpose of a continuity test
- Perform tests for short circuits
- Perform resistance tests on resistors, fuses, solenoids, relays, switches, transformers, motors, and semiconductors
- Measure current by using a direct series connection or by using a clamp-type ammeter
- Measure the output voltage of a DC power supply and the voltage of an AC feeder line
- Measure voltage at disconnect switches, circuit breakers, contactors, and transformers
- Perform voltage tests on circuit boards, PLC systems, and motor circuits

Inspection and Testing of Welds

Objectives:

- Outline the duties of the inspector and the process of inspecting equipment
- Explain non-damaging tests that use air, water, and oil as well as the use of radiography, X-rays, and the polariscope in detecting defects
- Identify the various code and testing requirements such as the American Tentative Standard Code for Pressure Piping
- Interpret drawings of welded parts, including the specialized welding symbology
- Describe the spectrographic and magnetic particle methods of inspection

Gas Tungsten Arc Welding (GTAW)

Objectives:

- Describe the advantages and limitations of gas tungsten arc welding
- Identify the variables involved in gas tungsten arc welding, and describe how you can control them to obtain desired welding results
- Select the equipment appropriate for various GTAW and PAW operations and describe how to set up, use, shut down, and care for this equipment
- Identify the different types of commonly used tungsten electrodes, and describe how to select, prepare, and use these electrodes effectively and economically
- Recognize the advantages and disadvantages of the various shielding gases and gas mixtures available so you can intelligently choose the gas appropriate for a specific welding operation

Fabrication of Pipe by Welding Part 1

Objectives:

- Identify where pipelines are used, the reliability of pipelines, the effects of pipe threads, and ways to determine pipe wall thickness
- Explain how pipe dimension are specified by both weight and the schedule system as well as how pipe is made
- Identify the common compositions of pipe and their designations
- Explain what fittings are available as standard items and how to make fittings
- Describe the many techniques for aligning pipes, flanges, and connections

Fabrication of Pipe by Welding Part 2

Objectives:

- Describe the applications, advantages, and limitations of the welding processes in the fabrication of pipe
- Identify the joint designs, welding rods for each composition, and preheating and postheating procedures
- Explain the process of piping copper, aluminum, nickel, lead, and titanium