

Curriculum Guide
Program Area: Welding

Standard 1.0 - LAYOUT AND FIT UP PROJECT FROM BLUEPRINTS					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
1.1	Interpret drawings, symbols, and procedures	Symbol, Drawings and Procedures	<p>Pictures to identify terms</p> <p>Using symbols arrow, reference line, root opening, intermittent fillet, melt through weld, slot weld</p> <p>What is the information on a welding procedure sheet</p> <p>Which weld is used for a lap joint</p> <p>Examples and types, used for corner, T and butt welds</p> <p>The information above the reference line indicates the other side</p> <p>Types of fillet Intermittent Convex Concave Staggered</p> <p>Types of weld Melt through Plug weld Back Weld</p>	<p>Joint root</p> <p>Bevel angle</p> <p>Groove angle</p> <p>Radius</p> <p>Reference line</p> <p>Fillet</p> <p>Intermittent</p> <p>Convex</p> <p>Concave</p> <p>Staggered</p> <p>Melt through</p> <p>Plug weld</p> <p>Back Weld</p>	x

Curriculum Guide
Program Area: Welding

			Math Problem Calculate building up a piece of steel (determine how much metal is needed)		
1.2	Use measuring devices	Use measuring devices	Metal cut in sections calculate loss of metal after it is cut, figure out how long is the left over piece Calculate square footage Calculate math problems Measuring tools used to measure angels	Protractor Angles Degrees Measuring tape	x
				Square Gauges Calipers	
1.3	Lay out projects from blueprints		Draw lines on a steel plate Level a bubble on with a glass on it Soapstone and its use Math Problem Express in scientific notation for volume of weld deposit for a V-groove (exchanging cubic inches to a scientific notation)	Soapstone Level Weld Flush Volume	x

Curriculum Guide
Program Area: Welding

			Determine the volume required to make a weld flush		
			Identify parts (materials) Identify processes Project Concept Order of operation Produce a prototype	Prototype	
1.4	Measure and cut materials		Maximum angle allowed in a 60 degree V Groove with a tolerance of plus 10 degrees /-5 degrees Adding fractions Determine how to use and when to use a 12 inch combination square (to mark parallel distinguish among bending grinding milling and shearing lines, 40 degree angles and a 12 inch line) PAC Plasma Arc Cutting PAW Plasma Arc Welding Mechanical cutting process Band saw 4 inch grinder Chop saw Distinguish between Welding, cutting, braising and soldering processes	TACK Temporary Weld Braising	x

Curriculum Guide
Program Area: Welding

			Calculate Math problems		
			OFC PAC Demonstrate abrasive (band, chop, cold)	Shears OFC PAC Abrasive	
1.5	Tack materials into position for welding		What number and letter designation for a weld on a plate in the flat position One would feather a tack with a file or a grinder on an open root groove weld		x
			Apply joint fit up		
STANDARD 2.0 – SET UP AND USE CUTTING EQUIPMENT					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
2.1	Set up and use oxyfuel equipment		Drag -amount of offset between the cut entry and the exit points produced during OFC (Oxyfuel cutting) Flame cut Components of oxyacetylene torch body and cutting attachment Cutting orifice, tip nut and slip-in tip KERF Gap produced by the flame cutting operation	Drag Flame cut KERF	x

Curriculum Guide
Program Area: Welding

			<p>What determines the size of a cutting tip? The thickness of the material</p> <p>The amount of oxygen required for cutting operations vs. welding</p> <p>What is the first thing you do to ignite the flame on the cutting torch? Open the acetylene needle valve</p> <p>Which material offers the best result when using the oxyfuel cutting process? mild steel</p> <p>How do you store oxyfuel cylinders? With safety caps and securely chained</p>		
			Identify components (supply bottles oz/act, gauges limits/settings, Torch operation, parts and pressure)		
2.2	Set up and use plasma arc cutting equipment		<p>What does plasma do? gas heated to conduct electricity</p> <p>Using PAC process what condition should the air be? Dry</p> <p>Toxic fume are given off when plasma cut galvanized steel</p>	<p>Plasma Arc Cutting PAC Toxic Galvanized steel Sputtering Compressed Air</p>	x

Curriculum Guide
Program Area: Welding

			<p>The torch is sputtering and hissing because moisture entering the system</p> <p>What 2 substances aid in pushing the arc through the cup inert gas or compressed air</p>		
			<p>Demonstrate equipment set up</p> <p>Practice safety when using equipment</p> <p>Equipment and cut evaluation</p>		
2.3	Set up and use air carbon arc cutting equipment		<p>Using carbon arc cutting –air how do you remove molten metal compressed air blows the metal away</p> <p>Normal air pressure supplied to a heavy duty air carbon arc electrode holder 80 to 100 psi</p> <p>4 electrode rods, copper-coated, steel coated, tungsten coated, zinc coated When are they used?</p> <p>Describe the difference between an electrode holder and an air clean carbon arc torch</p> <p>Identify differences between an electrode holder and an air carbon arc torch</p>		x

Curriculum Guide
Program Area: Welding

			Torch- demonstrate and apply		
			Determine amperage		
2.4	Set up and use semi-automatic cutting equipment		Another name for a n automatic cutting torch track cutter		x
			What should be considered when setting up an oxyfuel track torch? material type and thickness		
STANDARD 3.0 – SET UP AND USE SHIELDED METAL ARC WELDING (SMAW) EQUIPMENT					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
3.1	Set up SMAW equipment		Difference between: Amperage Voltage OHMS Resistance Output SMAW is stated by amperage 2 factors that determine the amperage setting is the metal thickness and electrode size cc Constant Current Welding processes GMAW FCAW SAW SMAW Shielded metal ARC welding GTAW	Amperage Voltage OHMS Resistance GMAW FCAW SAW SMAW Shielded metal ARC welding GTAW Filler meta Bose Metal Electrodes	x

Curriculum Guide
Program Area: Welding

			<p>3 things needed to perform the SMAW Filler metal Base Metal Electricity</p> <p>DCEP Direct Current electrode positive</p> <p>What does voltage measure Electrical pressure?</p> <p>How is wattage calculated volt x amps?</p> <p>An open circuit describes the voltage at the electrode prior to striking the arc</p>		
				DC/AC	
3.2	Identify and use types, storage, and handling of electrodes		<p>Which electrode is suited for welding high carbon steel? E7018</p> <p>Electrode similar to E6010 is E 6011</p> <p>Electrode with highest tensile strength and when to use E7014 and used with mild steel</p>	Electrode oven	x

Curriculum Guide
Program Area: Welding

			<p>Where is low hydrogen electrodes for the SMAW process stored</p> <p>Minimum temperature setting to store low hydrogen electrodes once they have been removed from the sealed container 250 degrees F</p> <p>To what length is an electrode used-up to the identification numbers</p> <p>What do the first 2 digits of an electrode classification refer to?</p> <p>What is the purpose of rod oven</p> <p>The minimum amount of tinsel strength</p> <p>To keep the moisture out of rod coating</p>		
			Identify tinsel strength	Tinsel strength	
3.3	Make fillet weld (all positions) on carbon steel in flat position (all positions not required for S.E.N.S.E)		<p>2 methods of striking an arc scratching and tapping</p> <p>3 things that determine weld quality travel speed, length of arc and amperage</p> <p>What direction is recommended when SMAW vertical welding upward</p>	<p>Heat-affected zone (AJZ)</p> <p>Effective throat</p> <p>Kindling point</p> <p>Melting point</p> <p>Crackling</p> <p>Porosity</p> <p>Wide beads</p>	x

Curriculum Guide
Program Area: Welding

			<p>direction</p> <p>Criteria that determine a weld quality include ARC length, travel speed and amperage</p> <p>What arc link is used when welding in the overhead positions Short</p> <p>What do you do if the puddle becomes too hot while welding decrease the amperage</p> <p>What is the appropriate arc length after striking the SMAW arc, Diameter of the rod</p> <p>Explain Heat-affected zone (AJZ) Effective throat Kindling point Melting point</p> <p>When are these methods used Pre-heat/post-heat slow the cooling rate of base metal Shorter arc length Faster travel speed Decrease amperage</p> <p>What cause these when using the GTAW process</p>		
--	--	--	--	--	--

**Curriculum Guide
Program Area: Welding**

			Narrow beads fast travel speed Crackling Porosity Wide beads		
3.4	Hard face and build up steel surface with SMAW equipment		What is used in surface build up operation GMAW SMAW GTAW Welding position and when to use Flat Overhead Horizontal Vertical Welding techniques and when to use Weaving Dragging Pulling Whipping Functions of padding/padding weld Surface build up Abrasion resistance Surface repair	Dragging Pulling Whipping Functions of padding/padding weld Surface build up Abrasion resistance Surface repair	x
STANDARD 4.0 – SET UP AND USE GAS METAL ARC WELDING (GMAW) EQUIPMENT (MIG)					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
4.1	Set up GMAW equipment		GMAW Gas Metal Arc Welding	GMAW Electrode	x

Curriculum Guide
Program Area: Welding

			<p>What are the cables for SMAW, GTAW and FCAW</p> <p>Copper</p> <p>Proper set up for GMAW welding produces a crackling and sizzling sound</p> <p>Which welding process uses a continuous consumable wire electrode</p> <p>A v-groove smooth drive roll is used with a solid wire</p>		
			<p>Basic electrode designation</p> <p>Assess storage procedures</p>		
4.2	Identify and use types and handling of filler material		<p>Most common wire for welding low carbon steel using GMAW E70s-6</p> <p>American welding society established electrode wire classification</p> <p>In the E70s-6 What do the first 2 numbers indicate Rod tinsel strength</p> <p>Classification code of 2% thoriated tungsten EWTH-2</p>		x

Curriculum Guide
Program Area: Welding

			The contact tip makes the connection from the gun to the filler metal		
4.3	Select and use proper gases appropriately		What gas is used is GMAW welding Co2 mixed What is used to shield the molten metal during a GMAW weld inert gasses What causes insufficient gas flow during a GMAW weld Precocity	Molten	x
4.4	Make flat and horizontal fillet welds on carbon steel		Methods of metal transfer in the GMAW process Spray Arc Short circuit What is the subsurface at the toe of the weld defect undercut The back hand travel angle is used on thin materials when using GMAW	Incomplete Fusion Cracking Undercut Arc Strike	x
			Build up joints		
4.5	Perform routine maintenance on GMAW wire feed assembly		Purpose of a wire feeder is it provides a steady supply of wire to a GMAW weld What is birdnesting in GMAW Incorrect wire feed	Birdnesting Conduit Liners	x

Curriculum Guide
Program Area: Welding

			How do you clean the conduit liner in a GMAW system		
			Compressed air		
STANDARD 5.0 – SET UP AND USE OXYFUEL EQUIPMENT					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
5.1	Set up oxyfuel equipment to industry standards		<p>What do the gauges on the regulator indicate</p> <p>Pressure in the cylinder</p> <p>Working pressure</p> <p>The red welding hose carries Fuel</p> <p>What types of thread make up the acetylene hose connectors?</p> <p>Left handed threads</p> <p>What color is the oxygen hose on the oxyfuel cutting equipment ? Green</p> <p>How do you test an oxysetlin for leaks</p> <p>test the connectors with non-flammable soap suds</p> <p>2 reasons of a regulator on a oxyseteling cutting torch</p> <p>Reduce cylinder pressure to torch pressures</p>	Acetylene Oxysetlin	x

Curriculum Guide
Program Area: Welding

			<p>Keep pressures constant</p> <p>How do you identify tip sizes</p> <p>Where is an empty cylinder marked when it is stored, near the top</p> <p>How many feet should oxygen be separated from fuel gasses 20</p>		
5.2	Weld carbon steels flat position (not required for S.E.N.S.E.)		<p>What causes burn through the torch is move forward too slowly</p> <p>Where is the filler wire applied to the puddle, in front of the puddle</p> <p>Purpose of a filler rod join metals</p> <p>What method is best used when welding carbon steel Push motion</p>		x
STANDARD 6.0 – SET UP AND USE GAS TUNGSTEN ARC WELDING (GTAW) EQUIPMENT (TIG)					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
6.1	Set up GTAW equipment		<p>Color code for 100% coude tungsten electrode green</p> <p>Type of welding machine for all types of GTAW welding AC/DC with high frequency</p>	Tungsten	x

Curriculum Guide
Program Area: Welding

			<p>How do electrodes GTAW differ from those used for SMAW welding None consumable fro GTAW</p> <p>What is the function of the Tungsten electrode in the GTAW process carries the current to the work</p> <p>2 basic types of GTAW torches Water cooled Air cooled</p>		
			<p>Identify, set up, safely use and maintain equipment.</p> <p>Classify electrodes</p>	<p>OFW Oxyfuel welding EBW Electron Beam welding LBW Laser Beam welding SAW Submerges arc welding</p>	
6.2	Identify and use types and handling of filler material		<p>Type of equipment for grinding and sharpening tungsten electrodes Bench grinder</p> <p>Recommended filler metal using GTAW process for base metal that is 316 grade stainless ER316L</p> <p>OFW Oxyfuel welding EBW Electron Beam welding LBW Laser Beam welding SAW Submerges arc welding</p>	hexavalent chromium	x

Curriculum Guide
Program Area: Welding

			<p>Predominate hazard of welding stainless steel hexavalent chromium</p> <p>Non consumable electrode used in the GTAW process Tungsten</p>		
			Classify, evaluate and store		
6.3	Select and use gases appropriately		<p>Commonly used shielding gas for GTAW welding Argon, Helium</p> <p>What determines proper free flow and post flow times to protect tungsten and the weld Base metal type</p>	Argon	x
			<p>Classify types</p> <p>Contrast pressures</p>		
6.4	Weld aluminum		<p>Best method for cleaning aluminum a stainless steel wire brush</p> <p>The best current to weld aluminum with GTAW AC-HF</p> <p>Which electrode is recommended for welding aluminum with GTAW EWP</p>		x

**Curriculum Guide
Program Area: Welding**

			Classify types Classify electrodes Apply settings Evaluate welds Apply safety		
6.5	Weld stainless steel		What material is welded with ER 308 Stainless steel 316 grade stainless steel would use ER316L filler in the GTAW process Hexavalent chromium is the predominant hazard of welding stainless steel	Hexavalent chromium	x
6.6	Weld carbon steels		What method is used to start a GTAW arc with our touching the metal high frequency start Describe how the tungsten tip should be prepared for GTAW on carbon steel Tungsten electrodes in GTAW are non-combustible		x
			Classify types Classify electrodes Apply settings Evaluate welds Apply safety		
STANDARD 7.0 – SET UP AND USE FLUX CORED ARC WELDING (FCAW) EQUIPMENT					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item

Curriculum Guide
Program Area: Welding

7.1	Set up FCAW equipment		<p>Similarity between FCAW and the GMAW both use a CV power supply Most common GMAW electrode diameters for welding ¼ inch to ½ inch mild steel .035 inch to .045 inch</p> <p>FCAW classification E71-T what does the 1 refer, a welding position What does duty cycle mean on a welding machine rated output without over heating</p> <p>How do you change polarity on a welder manually reverse the cables</p> <p>What polarity is used in FCAW NR-211 wire Straight</p> <p>What type of gas is used for FCAW-G5 wire carbon</p> <p>Carbon cause nausea so breaks are needed by workers</p>		x
			<p>Identify equipment: Power supply Drive roll system Guns, Linevers set up</p>		
7.2	Identify and use types, storage, and handling of filler material		<p>Features required in a FCAW system</p> <p>Purpose of flux in FCAW deoxidizes</p> <p>What does the t in the FCAW</p>		x

Curriculum Guide
Program Area: Welding

			<p>electrode classification E71-T1 represents tubular</p> <p>How does the FCAW wire differ from GMAW wire Its tabular</p>		
			<p>Identify wire: Diameter Classification (E71T1)</p> <p>Identify Shielding characteristics: deoxidizers, flux</p>	Deoxidizers Flux	
7.3	Make fillet welds (all positions) on carbon steel		<p>When welding in the overhead position what will the low amperage cause low penetration</p> <p>MSDS Explain what they are</p> <p>What does a narrow bead with pointed ripples indicate about travel speed its too fast</p> <p>Which is essential of gun-to-work surface in FCAW</p>	MSDS Amperage Ripple	x
			<p>Demonstrate all welds in all positions</p> <p>Bead appearance (travel, speed, WTD)</p>		
7.4	Perform maintenance on FCAW wire feed assembly		<p>What happens if the FCAW/GMAW contact tip is worn There is poor arc starts</p> <p>When upsize or downsize the type of</p>	Upsize Downsize	x

Curriculum Guide
Program Area: Welding

			wires what changes do you have to make to FCAW equipment drive rolls liner contact and tip		
			What can be done to help wire flow through the liner for a better feed? Wax it		
			Identify and perform maintenance		
STANDARD 8.0 – USE AUXILIARY EQUIPMENT AND TOOLS					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
8.1	Use power saw/abrasive wheel to cut material	<p>Wear eye and ear protection Secure metal so it won't move</p> <p>Why is a special rated grinding wheel required when grinding aluminum grinding will plug up causing it to over heat</p> <p>What should an operator do first when using a abrasive cut saw read the instruction manual</p>	<p>2 basic safety systems for hand tool protection against electrical shock external grounding or double insulation</p> <p>What should be done to ensure safety using cutoff saw to cut a piece of metal Check blade for crack</p> <p>When using a steel chop saw and too much downward pressure what is the result skewed cut</p>	Grinding stone Steel Chop	x
8.2	Use power equipment to wire brush metal		The c-clamp is used to hold an item in place when grinding	C- clamp	x

Curriculum Guide
Program Area: Welding

			<p>Safety rules for power tools Keep work are well lighted Wear a dust or face mask Use the correct tool for the job</p> <p>What is wire brush used for grease</p>		
8.3	Use multi-purpose shear and punch		<p>Why is work secured before cutting to make sure cut is straight The best cutting tool for making straight dross free cuts in sheet metal is power sheers</p>	Dross free	x
8.4	Use metal brake		<p>Which tool is best for making a tray with 4 sides out of flat piece of sheet metal box and pan brake Which tool is used to bend sheet metal brake</p>		x
8.5	Use metal roller		<p>What is a slip roller used for used to make funnels cylinders and cones</p> <p>If the sheet metal is not curing on the sheet roller what should be done tighten the pressure nob</p>	Slip Roller	x
8.6	Use drilling equipment		<p>If the metal shavings coming out of the hole become too long what should be done reduce downward pressure</p> <p>What can be done to harden a drill bit set it in oil</p> <p>Indicators of a dull drill bit</p>		x

Curriculum Guide
Program Area: Welding

			No forward progress Vibration High pitched squeal		
STANDARD 9.0 – PERFORM WELDMENT TESTING					
Measurement Criteria		Concepts	Implementation	Terminology	Testing Item
9.1	Describe nondestructive test		<p>Dyepenetrant inspection is used to locate surface breaking defects in non-porous materials</p> <p>What welding defect is be considered the most severe crack</p> <p>What code covers the welding of steel structure AWS D1.1</p> <p>What is the least expensive form on NDT (Non Destructive testing) Visual</p> <p>What welding defect is characterized by foreign material trapped in the weld metal slag inclusions</p> <p>What weld defect is characterized by sponge like holes throughout the weld metal porosity</p> <p>What weld defect is characterized by a lack of bond between two metals incomplete fusion</p>	<p>Dyepenetrant inspection</p> <p>NDT</p> <p>Porosity</p> <p>Fusion</p>	x
			Dye Penetrant	Dye Penetrant	

Curriculum Guide
Program Area: Welding

			Magnetic Paricle Ultrasonic Test	Magnetic Paricle Ultrasonic Test	
9.2	Perform destructive test		Which test is not a guided bin test Fillet What are destructive test Tinsel strength Guided bend Fillet weld bend What destructive test requires the weld to be pulled apart until it breaks tinsel A bend test of a plate coupon is to determine Cracks Yield strength Surface precocity	Face Side Root Cracks Yield strength Surface precocity	x
			Tensile impact		

Terminology

A

Abrasion resistance – ability of a surface to resist surface wear caused by rubbing, contact with another material.

Abrasive – Material used for polishing or cleaning a hard surface by rubbing or grinding.

Acetylene – a colorless pungent-smelling fuel gas used as a fuel source with oxygen for welding and cutting operations.

Curriculum Guide

Program Area: Welding

Amperage – Flow of electrons, and strength of current in amperes.

Arc – Point of heat generation by electric contact between electrode and workpiece.

Argon – colorless, odorless inert gas used as shielding in GTAW and some GMAW applications

B

Back Weld – A weld deposited at the back of a single groove weld

Bevel angle - The angle formed between the prepared edge of a member and a plane perpendicular to the surface of the member.

Bird nesting – characterized as the tangling of wire that halts from being fed through the machine.

Base Metal – One or two metals to be welded together to form a joint

Brazing - a metal-joining process whereby a filler metal is heated above melting point and distributed between two or more close-fitting parts by capillary action. The filler metal is brought slightly above its melting temperature while protected by a suitable atmosphere, usually a flux.

C

C- clamp - is a type of clamp device typically used to hold a wood or metal workpiece

Calipers - an instrument for measuring external or internal dimensions, having two hinged legs resembling a pair of compasses and in-turned or out-turned points.

Compressed Air - air kept under a pressure that is greater than atmospheric pressure. It serves many domestic and industrial purposes.

Concave – a fillet weld where the maximum distance from the face is less than the line joining the weld toes.

Conduit Liners – guides the welding wire from the machine feed rollers to the welding gun

Curriculum Guide

Program Area: Welding

Convex – a fillet weld where the maximum distance from the face is greater than the line joining the weld toes.

Crackling – sound produced by the mig welding process which usually indicates lack of shielding gas.

Cracks – A fracture type discontinuity characterized by a sharp tip and high ratio of length and width to opening displacement.

D

Degrees (1st definition) - a unit of measurement used in determining the angle of a particular work-piece, i.e. “weld this pipe to the base at a 45 degree angle”.

Degrees (2nd definition) – a unit of measurement to determine heat i.e. “this weld must be done at 1275 degrees Farenheit in order to achieve proper penetration”.

Deoxidizers – compounds that must be added to molten steel to remove excess oxygen as the molten steel cools.

Discontiuity - An interruption of the typical structure of a weld, i.e. cracks, undercut, inclusions, etc.

Drag - the horizontal distance between the point of entrance and the point of exit of a cutting oxygen stream.

Dragging – a technique in which the arc is kept at the front of the puddle. (AKA pulling the puddle)

Dross free – cutting metals with a clean edge i.e. “this part has dross free edges”. Dross is sometimes called slag.

Dye Penetrant Inspection (DPI) - also called liquid penetrant inspection (LPI) or penetrant testing (PT), is a widely applied and low-cost inspection method used to locate surface-breaking defects in all non-porous materials (metals, plastics, or ceramics).

E

Curriculum Guide

Program Area: Welding

Electron Beam Welding (EBW) - a fusion welding process in which a beam of high-velocity electrons is applied to two materials to be joined. Used in welding titanium, aluminum, plastics, and also two different metals.

Effective Throat - The minimum distance, minus any convexity, between the weld root and the face of the fillet weld.

Electricity Definitions

Alternating Current (AC) - an electric current that reverses its direction many times a second at regular intervals.

Direct Current (DC) - Electrical current that flows only in one direction.

Amperage- Flow of electrons and strength of current in amperes.

OHM - the standard unit of electrical resistance in the International System of Units

Electrode – (For metal arc welding) Filler metal in the form of a wire or rod, whether bare or covered, through which current is conducted between the electrode holder and the arc.

Electrode Oven – A specially designed oven in which to electrodes of all types are place to keep them from deteriorating.

F

Face - The exposed surface of a weld, made by an arc or gas welding process, on the side from which welding was done.

FCAW- The acronym for Flux Cored Arc Welding.

Filler Metal - Metal to be added in making a weld (AKA rod or wire).

Fillet Weld- A weld of approximately triangular cross section, as used in a lap joint, joining two surfaces at approximately right angles to each other.

Curriculum Guide

Program Area: Welding

Flame Cutting – Flame cutting or “burning” of carbon steel plate is an effective and efficient way to cut carbon and alloy steel plate to size and shape

Flush: a flush weld has the same finished height as the surrounding surface.

Flux - A cleaning agent used to dissolve oxides, release trapped gases and slag, and to clean metals for welding, soldering, and brazing.

Functions of padding/padding weld - A succession of overlapping beads or spreading welds, merging so as to result in an even surface.

G

GMAW – The acronym for Gas Metal Arc Welding.

Grinding Wheel - a wheel used for cutting, grinding, or finishing metal or other objects, and typically made of abrasive particles bonded together.

GMAW – The acronym for Gas Metal Arc Welding.

Grinding Wheel - a wheel used for cutting, grinding, or finishing metal or other objects, and typically made of abrasive particles bonded together.

Groove Angle - The total included angle of the groove between parts to be joined by a groove weld.

Groove Weld: A weld made by depositing filler metal in a groove between two workpieces.

GTAW – The acronym for Gas Tungsten Arc Welding.

H

Heat-Affected Zone - That portion of the base metal whose structure or properties have been changed by the heat of welding or cutting.

Curriculum Guide

Program Area: Welding

Hexavalent Chromium – A by-product of welding stainless steel and other alloys that contain chromium, that is known to cause cancer. In addition, it targets the respiratory system, kidneys, liver, skin and eyes. It also occurs in pigments, spray paints and coatings.

I

Incomplete Fusion – This happens when there is a lack of atomic bonding of the metal being welded.

Intermittent Weld - A type of fillet weld that is not continuous across a joint. AKA "skip weld".

J

Joint Root- a butt joint where the two pieces are joined

K

Kerf - The space from which metal has been removed by a cutting process.

Kindling Point – The temperature at which steel melts, which is 2600 – 2800 degrees Fahrenheit, depend on the carbon content of the material being cut.

L

Laser Beam Welding (LBW) - a welding technique used to join multiple pieces of metal through the use of a laser. The beam provides a concentrated heat source, allowing for narrow, deep welds and high welding rates.

Curriculum Guide

Program Area: Welding

Laser Fusion Brazing – a process used to weld galvanized steel.

Level- device for establishing a horizontal plane.

M

Magnetic Particle: magnetized part and finely divided iron particles to outline discontinuities in the parent metal or weld

Measuring tape: A tape measure or measuring tape is a flexible ruler. It consists of a ribbon of cloth, plastic, fiberglass, or metal strip with linear-measurement markings. It is a common measuring tool. Its design allows for a measure of great length to be easily carried in pocket or toolkit and permits one to measure around curves or corners

Melt through: visible root reinforcement in a joint welded from one side.

Melting point: The temperature at which a solid becomes a liquid. Welding requires metals to reach their melting points.

Molten: molten metal pool which is controlled while welding to create a bead which joins the pieces of metal together. Weld pool

MSDS: A material safety data sheet (MSDS), safety data sheet (SDS),^[1] or product safety data sheet (PSDS) is an important component of product stewardship and occupational safety and health. It is intended to provide workers and emergency personnel with procedures for handling or working with that substance in a safe manner, and includes information such as physical data (melting point, boiling point, flash point, etc.), toxicity, health effects, first aid, reactivity, storage, disposal, protective equipment, and spill-handling procedures. MSDS formats can vary from source to source within a country depending on national requirements.

N

NDT: Nondestructive testing or Non-destructive testing (NDT) is a wide group of analysis techniques used in science and industry to evaluate the properties of a material, component or system without causing damage.

O

Curriculum Guide

Program Area: Welding

OFC: In oxy-fuel cutting, a torch is used to heat metal to its kindling temperature. A stream of oxygen is then trained on the metal, burning it into a metal oxide that flows out of the kerf as slag

OFW Oxyfuel welding: In oxy-fuel welding, a welding torch is used to weld metals. Welding metal results when two pieces are heated to a temperature that produces a shared pool of molten metal. The molten pool is generally supplied with additional metal called filler. Filler material depends upon the metals to be welded.

OHMS: The ohm is the SI derived unit of electrical resistance

Oxyacetylene: Oxygen and Acetylene Gas

P

PAC: Plasma Arc Cutting Plasma cutting is a process that is used to cut steel and other metals of different thicknesses (or sometimes other materials) using a plasma torch. In this process, an inert gas (in some units, compressed air) is blown at high speed out of a nozzle; at the same time an electrical arc is formed through that gas from the nozzle to the surface being cut, turning some of that gas to plasma. The plasma is sufficiently hot to melt the metal being cut and moves sufficiently fast to blow molten metal away from the cut.

Plug weld: A plug weld is used to fasten two pieces of metal together using a welder. When joining the pieces, a hole is drilled into the top piece and it is laid over the bottom one. A weld is then made by running a bead inside of the drilled hole, thereby holding the two pieces together. (wiseGEEK)

Porosity: porosity is a discontinuity in a weld caused by improper prep, paint, rust, trapped gas or slag. Improper travel work and travel angle. It will cause a weld to fail inspections and testing.

Prototype: A prototype is an early sample, model or release of a product built to test a concept or process or to act as a thing to be replicated or learned from.

Protractor Angles: A protractor is a rectangular, square, circular or semicircular measuring instrument, typically made of transparent plastic or glass, for measuring angles. Most protractors measure angles in degrees

Pulling: Welding with the gun or electrode pointed back toward the molten pool. Dragging

Curriculum Guide

Program Area: Welding

R

Radius: a straight line from the center to the circumference of a circle or sphere.

Reference line: the primary element of any welding symbol.

Resistance: See Ohm

Ripples: The even and consecutive curved lines on the surface of a weld after it has solidified.

Root of weld: The points, as seen in cross section, at which the bottom of the weld intersects the base metal surfaces.

S

SAW- Submerged Arc Welding: An arc welding process in which fusion is produced by heating with an electric arc or arcs between a bare metal electrode or electrodes and the work. The welding is shielded by a blanket of granular, fusible material on the work. Pressure is not used. Filler metal is obtained from the electrode, and sometimes from a supplementary welding rod.

Shears: This can be a small hand tool or a large machine to cut (shear) metal.

Side:

Slip Roll: This is a machine which can be powered or hand operated that is used to form pieces of metal.

SMAW- Shielded Metal Arc Welding: Also known as stick welding, is a process which melts and joins metals by heating them with an arc between a coated metal electrode and the work-piece. The electrode outer coating, called flux, assists in creating the arc and provides the shielding gas and slag covering to protect the weld from contamination. The electrode core provides most of the weld filler metal.

Curriculum Guide

Program Area: Welding

Soapstone: Used to mark cut lines on metal. Must be cleaned off of surfaces to be welded.

Sputtering: When using the GMAW process, if sputtering occurs, that is usually a sign that the wire speed is too high or the amperage too low, or some combination of the two.

Square: This is a measurement tool that assures that corners are square i.e. at 90 degrees.

Staggered Weld: a type of weld, usually done on T-joints, where the beads of a specified length (1", 2" etc.) are placed alternately on either side of the joint.

Striker: a friction device which is used to ignite an oxy-fuel torch.

Surface build up-AKA Surfacing Weld: This is the only type of weld that is applied to only one base metal surface. It is used to build up a base surface that has either become worn below the desired thickness or dimension, or to add strength and stability to a base by adding material to it. (Note, ("Surfacing Weld" is correct AWS nomenclature)

Surface Porosity: Gas bubbles trapped in the weld material cause this porosity. Surface porosity indicates porosity throughout the weld.

Surface repair: See Surfacing Weld

T

Tack Weld: welds made to hold the parts of a work-piece in proper alignment until the final welds are made".

Temporary Weld: Welds made to attach a piece or pieces to a weldment for temporary use in handling, shipping, or working on the weldments".

Tensile Strength: the ability of a material or object to be stretched or pulled without breaking. Tensile strength is usually measured in PSI (Pounds Per Square Inch).

Toxic: containing or being poisonous material especially when capable of causing death or serious debilitation i.e. the fumes from welding contain toxic compounds, therefore it is necessary to prevent welders from inhaling.

May 2015
Revised 8- 2015
Welding

Curriculum Guide

Program Area: Welding

Tungsten: a hard steel-gray metal of the transition series. It has a very high melting point (3410°C). The electrodes used in GTAW are made primarily of tungsten.

U

Ultrasonic Testing: Ultrasonic Testing (UT) uses high frequency sound energy to conduct examinations and make measurements. Ultrasonic inspection can be used for flaw detection/evaluation, dimensional measurements, material characterization, and more.

Undercut: a groove melted into the base metal at the weld toe or weld root that is left unfilled by weld metal. The groove concentrates stress on the weld, and is considered a defect.

V

Voltage: voltage is a measure of electrical energy. Think of voltage as the pressure which pushes electrical current through a conductor, like water through a hose.

Volume: calculating the volume of a weld is one of the first steps to be taken when estimating the cost of making a weld. With this information, and knowing the deposition rate of the process, it is possible to determine the arc time (the length of time that an arc is burning and depositing weld metal) and the amount of welding consumables required to fill the joint. Both of these are required in order to calculate the cost of making the weld.

W

Whipping: whipping is a technique used primarily for the root pass in a groove weld. It consists of slightly moving the electrode back and forth along the line of the weld while staying in the “puddle” all the time.

Curriculum Guide

Program Area: Welding

Wide beads: wide beads are caused by a larger amount of transverse oscillation (side-to-side movement of the rod or wire) used by the welder, or slower than specified travel speed. Most wide beads cause a larger heat-affected zone which can be a serious defect.

Y

Yield strength: yield strength or yield point of a material is defined in engineering and materials science as the stress at which a material begins to deform plastically. Prior to the yield point the material will deform elastically and will return to its original shape when the applied stress is removed. For example an E7018 filler rod has a tensile strength of 70,000 PSI and a yield strength of 57,000 PSI.