LESSON PLAN

Date______________ Trade:- Welder

Name____________ Week No:- Fifteen

Subject :- Gas Welding Filler rods, specification and sizes. Gas welding flux-types and functions. Gas brazing and soldering, principles, types fluxes & uses. Gas welding defects causes and remedies.

Motivations:- in previous week we learned about specifications of pipes, various types of pipe joints, pipe welding position and procedure. Difference between pipe and plate welding. Pipe development for elbow joint, Y joint and branch joint, manifold system.

PREPARATION: - Teaching Aids:-Chalk, Charts,

INTRODUCTION: -Filler rod is a materials which are used for fill the joint. A welding joint's strength mostly depend on filler rod. Quality of filler rod and base metal must be match.

PRESENTATION:-

Topic	Information Point	Spot Hint
Filler metal	**To fill the joint as per requirement called filler metal.**	
Types	**Alloy and non-alloy**	
Specifications	**For a strong weld joint we use alloy filler rod for different purpose.**	

Composition and properties
Organic fluxes typically consist of four major components
Activators - chemicals disrupting/dissolving the metal oxides. Their role is to expose unoxidized, easily wettable metal surface and aid soldering by other means, e.g. by exchange reactions with the base metals.
Highly active fluxes contain chemicals that are corrosive at room temperature. The compounds used include metal halides (most often zinc chloride or ammonium chloride), hydrochloric acid, phosphoric acid, and hydrobromic acid. Salts of mineral acids with amines are also used as aggressive activators. Aggressive fluxes typically facilitate corrosion, require careful removal, and are unsuitable for finer work. Activators for fluxes for soldering and brazing aluminium often contain fluorides.
Milder activators begin to react with oxides only at elevated temperature. Typical compounds used are carboxylic acids (e.g. fatty acids (most often oleic acid and stearic acid), dicarboxylic acids) and sometimes amino acids. Some milder fluxes also contain halides or organohalides.
Vehicles - high-temperature tolerant chemicals in the form of non-volatile liquids or solids with suitable melting point; they are generally liquid at soldering temperatures. Their role is to act as an oxygen barrier to protect the hot metal surface against oxidation, to dissolve the reaction products of activators and oxides and carry them away from the metal surface, and to facilitate heat transfer. Solid vehicles tend to be based on natural or modified rosin (mostly

abietic acid, pimaric acid, and other resin acids) or natural or synthetic resins. Water-soluble organic fluxes tend to contain vehicles based on high-boiling polyols - glycols, diethylene glycol and higher polyglycols, polyglycol-based surfactants and glycerol.
Solvents - added to facilitate processing and deposition to the joint. Solvents are typically dried out during preheating before the soldering operation; incomplete solvent removal may lead to boiling off and spattering of solder paste particles or molten solder.
Additives - numerous other chemicals modifying the flux properties. Additives can be surfactants (especially nonionic), corrosion inhibitors, stabilizers and antioxidants, tackifiers, thickeners and other rheological modifiers (especially for solder pastes), plasticizers (especially for flux-cored solders), and dyes.
Inorganic fluxes contain components playing the same role as in organic fluxes. They are more often used in brazing and other high-temperature applications, where organic fluxes have insufficient thermal stability. The chemicals used often simultaneously act as both vehicles and activators; typical examples are borax, borates, fluoroborates, fluorides and chlorides. Halogenides are active at lower temperatures than borates, and are therefore used for brazing of aluminium and magnesium alloys; they are however highly corrosive.
Fluxes have several important properties:
Activity - the ability to dissolve existing oxides on the metal surface and promote wetting with solder. Highly active fluxes are often of acidic and/or corrosive nature.
Corrosivity - the promotion of corrosion by the flux and its residues. Most active fluxes tend to be corrosive at room temperatures and require careful removal. As activity and corrosivity are linked, the preparation of surfaces to be joined should allow use of milder fluxes. Some water-soluble flux residues are hygroscopic, which causes problems with electrical resistance and contributes to corrosion. Fluxes containing halides and mineral acids are highly corrosive and require thorough removal. Some fluxes, especially borax-based brazing ones, form very hard glass-like coatings that are difficult to remove.
Cleanability - the difficulty of removal of flux and its residues after the soldering operation. Fluxes with higher content of solids tend to leave larger amount of residues; thermal decomposition of some vehicles also leads to formation of difficult-to-clean, polymerized and possibly even charred deposits (a problem especially for hand soldering). Some flux residues are soluble in organic solvents, others in water, some in both. Some fluxes are no-clean, as they are sufficiently volatile or undergoing thermal decomposition to volatile products that they do not require the cleaning step. Other fluxes leave non-corrosive residues that can be left in place. However, flux residues can interfere with subsequent operations; they can impair adhesion of conformal coatings, or act as undesired insulation on connectors and contact pads for test equipment.
Residue tack - the stickiness of the surface of the flux residue. When not removed, the flux residue should have smooth, hard surface. Tacky surfaces tend to accumulate dust and particulates, which causes issues with electrical resistance; the particles themselves can be conductive or they can be hygroscopic or corrosive.
Volatility - this property has to be balanced to facilitate easy removal of solvents during the preheating phase but to not require too frequent replenishing of solvent in the process equipment.
Viscosity - especially important for solder pastes, which have to be easy to apply but also thick enough to stay in place without spreading to undesired locations. Solder pastes may also function as a temporary adhesive for keeping electronic parts in place before and during soldering. Fluxes applied by e.g. foam require low viscosity.
Flammability - relevant especially for glycol-based vehicles and for organic solvents. Flux vapors tend to have low autoignition temperature and present a risk of a flash fire when the flux comes in contact with a hot surface.
Solids - the percentage of solid material in the flux. Fluxes with low solids, sometimes as little as 1-2%, are called low solids flux, low-residue flux, or no clean flux. They are often composed of weak organic acids, with addition of small amount of rosin or other resins.

Conductivity - some fluxes remain conductive after soldering if not cleaned properly, leading to random malfunctions on circuits with high impedances. Different types of fluxes are differently prone to cause these issues.
The surface of the tin-based solder is coated predominantly with tin oxides; even in alloys the surface layer tends to become relatively enriched by tin. Fluxes for indium and zinc based solders have different compositions than fluxes for ordinary tin-lead and tin-based solders, due to different soldering temperatures and different chemistry of the oxides involved.
The composition of fluxes is tailored for the required properties - the base metals and their surface preparation (which determine the composition and thickness of surface oxides), the solder (which determines the wetting properties and the soldering temperature), the corrosion resistance and ease of removal, and others.

Organic fluxes are unsuitable for flame soldering and flame brazing, as they tend to char and impair solder flow.

Some metals are classified as "unsolderable" in air, and have to be either coated with another metal before soldering or special fluxes and/or protective atmospheres have to be used. Such metals are beryllium, chromium, magnesium, titanium, and some aluminium alloys.

	Copper %	Zinc %	Tin %	Fe %	Mn %	Si %	Ni %	P %	Use	Melting Temp °F	Flow Temp °F
Brass Brazing Alloy	60	40							Copper, Nickel, Alloy, Steel	1650	1660
Naval Brass	60	39.25	.75						Copper, Steel, Nickel Alloys	1630	1650
Tobin Bronze	59	40.5	.50						Steel, Cast Iron	1625	
Manganese Bronze	58.5	39.25	1.0	1.0	.25				Steel	1590	1630
Low Fuming Bronze	57.5 52 50	40.48 48 50	.9	1.0	.03	.09			Cast Iron, Steel	1598 1570 1585	 1595 1610
Nickel Silver	55-65 48	27-17 42					18 10		Steel, Nickel Alloys, Cast Iron Steel, Nickel Alloys	 1690	 1715
Copper Silicon	98.25				.25	1.5			Steel to Copper	1981	
Phosphor Bronze	98.2		1.5					.3	Copper Alloys	1922	

Welding Wire/Method Recommendations

Wire Type	Considerations
Solid Carbon-Steel ER70S-6	May be used with CO2 or 75% Argon/25% CO2 (C-25), SteelMIX®, SteelMIX® 3 or SteelMIX® Extra
	CO2 gas provides deeper penetration
	75% Argon/25% CO2 has less spatter than CO2. SteelMIX(s) have less than either
	Indoor use with no wind
	For auto body, manufacturing, fabrication
	Welds thinner materials (22 gauge) than flux cored wires
Flux Cored/ Carbon-Steel E71T-GS	No shielding gas required
	Excellent for outdoor windy conditions
	For dirty, rusty, painted materials
	Hotter than solid wires, welds to 18 gauge materials and thicker
Solid Aluminum ER-4043 ER-5356	Must be used with Argon, AluMIX™, or other Argon/ Helium mixes
	Recommended to be used with spool guns for best results
	5356 is harder for stronger welds and easier feeding
Solid Stainless Steel ER308/308L	Use with StainMIX™ 3 or Helium/Argon/CO2 mixtures
	For 301, 302, 304, 305 and 308 stainless base metals

WFS Range Relationships For Short Circuit Transfer on Steel

Wire Size	Amperage Range	Wire Feed Speed Range
.023"	30-90	100-400
.030"	40-145	90-340
.035"	50-180	80-380
.045"	75-250	70-270

Rule of Thumb Metal Thickness - Amperage Needed

Gauge Number	Nearest Fraction Of An Inch	Rule Of Thumb Amperage
18	3/64" = .047	47
16	1/16" = .062	62
14	5/64" = .078	78
12	1/10" = .100	100
10	1/8" = .125	125
8	5/32" = .156	156
6	3/16" = .187	187

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Welding Wire Thickness Charts

Material Thickness	MIG Solid Wire Size			Gasless Flux-Cored Wire Size		
	.023"	.030"	.035"	.030"	.035"	.045"
22 Gauge (.031)	■	■				
20 Gauge (.037)	■	■		■		
18 Gauge (.050)	■	■	■	■	■	
16 Gauge (.063)		■	■	■	■	■
14 Gauge (.078)		■	■	■	■	■
1/8" (.125)		■	■		■	■
3/16" (.188)			■		■	■
1/4" (.25)			■			■
Amperage	30-90	40-145	50-180	40-145	50-180	75-250
Wire Speed ipm	100-400	90-340	80-380	90-340	80-380	70-270

Metal Thickness - Amperage Required

Gauge Number	Fraction Of An Inch	Amperage	Amps/Inch
18	3/64" = .047	47	Formula
16	1/16" = .062	62	
14	5/64" = .078	78	M X 1,000 = A
12	1/10" = .100	100	
10	1/8" = .125	125	
8	5/32" = .156	156	M = Material (.000")
6	3/16" = .187	187	A = Welding Amps

FAULT OR DEFECT	CAUSE AND/OR CORRECTIVE ACTION
1) POROSITY	A. OIL, HEAVY RUST, SCALE, ETC. ON PLATE B. WIRE – MAY NEED WIRE HIGHER IN Mn AND Si C. SHIELDING PROBLEM; WIND, CLOGGED OR SMALL NOZZLE, DAMAGED GAS HOSE, EXCESSIVE GASFLOW, ETC. D. FAILURE TO REMOVE GLASS BETWEEN WELD PASSES E. WELDING OVER SLAG FROM COVERED ELECTRODE
2) LACK PENETRATION	A. WELD JOINT TOO NARROW B. WELDING CURRENT TOO LOW; TOO MUCH C. ELECTRODE STICKOUT WELD PUDDLE ROLLING IN FRONT OF THE ARC
3) LACK OF FUSION	A. WELDING VOLTAGE AND/OR CURRENT TOO LOW B. WRONG POLARITY C. TRAVEL SPEED TOO LOW D. WELDING OVER CONVEX BEAD E. TORCH OSCILLATION TOO WIDE OR TOO NARROW F. EXCESSIVE OXIDE ON PLATE
4) UNDERCUTTING	A. TRAVEL SPEED TOO HIGH B. WELDING VOLTAGE TOO HIGH C. EXCESSIVE WELDING CURRENTS D. INSUFFICIENT DWELL AT EDGE OF WELD BEAD
5) CRACKING	A. INCORRECT WIRE CHEMISTRY B. WELD BEAD TOO SMALL C. POOR QUALITY QF MATER IAL BEING WELDED

Problem	Possible Causes	Remedy
A. Warping	1. Non-uniform quenching practice	Employ spray or agitated quench
	2. Improper support during heating	Support with brick, cast iron chips, or spent coke
	3. Release of machining stresses	Machine equal amounts from surface of part or anneal prior to heat treatment
	4. Unbalanced design	Clamp in fixture designed to balance mass
	5. Failure to strain relieve prior to heat treatment	Strain relieve
B. Dimensional changes	1. Release of stresses from previous cold working	Strain relieve prior to to hardening
	2. Unpredicted thermal stresses	Balance mass with quench fixture
	3. Severe quenching practice	Change to less severe quenching media or warm quench bath
	4. Failure to temper or stabilize properly	Employ stabilizing or sub-zero treatment
	5. Dimensional changes for some are predictable and normal	Use table supplied with steel to predict size change
	6. Transformation of retained austenite	Employ multiple tempers or sub-zero treatment
	7. Overheating or underheating	Check furnace control and recommended temperatures

Questions:-

1. What is gas welding flux and its function?
2. What is the need of filler rods?
3. What is porocity?

Next Lesson :- Electrodes, types, function of flux, coating factor, sizes of electrode. Coding of electrodes as per BIS, AWS. Moisture pick up of electrode. Storage and baking of electrodes. Special purpose electrode and their application.

Assignment:- Gas Welding Filler rods, specification and sizes. Gas welding flux-types and functions. Gas brazing and soldering, principles, types fluxes & uses. Gas welding defects causes and remedies.

Checked by………………………… Instructor………………..