

Handling of Aluminum Component During Fabrication

Introduction

- Aluminum is highly reactive metal. It has strong affinity for oxygen that oxidizes the surface of aluminum to form thin, hard oxide film. This oxide film protects the metal from corrosive atmosphere.
- The surface of aluminum oxide is porous. This can retain moisture or contaminate, which causes porosity in weld, if proper care is not taken.
- Hydrogen is highly soluble in molten Aluminum, which also causes porosity during welding.
- Aluminum melts at comparatively low temp. (660°C) and it has good conductivity and coefficient of expansion. It has 6% solidification shrinkage. All these characteristics cause distortion.
- Aluminum alloys are of two types:
 - a) Non Heat Treatable
 - b) Heat Treatable

Non Heat Treatable alloy components are not recommended to be heat treated after welding.

Heat Treatable alloy components require to be heat treated after welding, to achieve its properties.

Handling of Aluminum Component During Fabrication

Designation system of Wrought Aluminum

Alloy series	Principle alloying element	HT condition	Common Filler used for welding
1xxx (One thousand series)	99.00% min	Non Heat treatable	1188,1088,1068 1100
2xxx(2 thousand series)	Copper	Heat treatable	
3xxx(3 thousand series)	Manganese	Non Heat treatable	1100
4xxx(4 thousand series)	Silicon	Heat treatable	
5xxx(5 thousand series)	Magnesium	Non Heat treatable	5356, 5556
6xxx(6 thousand series)	Magnesium and silicon	Heat treatable	4043

Handling of Aluminum Component During Fabrication

- It is important to select proper filler to get defect free weld.

Factors influencing the filler alloy selection includes following:

- i) Freedom from Hot cracking
- ii) Weld metal strength
- iii) Weld metal ductility
- iv) Corrosion resistance
- v) Weld performance at elevated temp.
- vi) Weld metal fluidity
- vii) MIG wire feed ability
- viii) Weld metal colour match with base metal after anodizing

Handling of Aluminum Component During Fabrication

OBJECTIVE

To process the ALUMINUM components with utmost care to avoid any damage to the surface and quality of weld which will deteriorate the required corrosion properties.

RESPONSIBILITY

Following good engineering practices to be followed at each stage of operation:

Aluminum components are to be processed in isolated, specially identified area to avoid any contamination with C.S. components, dust and oil.

Handling of Aluminum Component During Fabrication

Plate handling

- i) Ensure physical good and acceptable condition of the component after receipt i.e. it should be free from Scratches, notches, blistered surface etc.
- ii) Store the plate/components separately in isolation i.e. it shall not be stored along with any carbon steel material.
- iii) The plate shall be coated with thin film of polymer to protect the surface.
- iv) Ensure that no grease, oil or any volatile material spills on the stored material.
- v) Ensure proper identification mark on the component. It shall be engraved .(Hard Punching is not allowed)
- vi) Ensure, while handling the plates/components, C.S. slings/supporting accessories shall not come in direct contact with the aluminum surface.

Handling of Aluminum Component During Fabrication

Cutting of Plates/components

- i) Cutting shall be done by PLASMA cutting process (Argon/ Nitrogen or argon/Hydrogen)
- ii) There shall not be deep cut marks on the weld edges of the components.
- iii) Do not use excessive heat during cutting.

Weld edge preparation

- i) Weld joint Edges shall be machined as per joint design.
- ii) Min 2-4mm of edge surface shall be machined to remove oxidized layer.
- iii) Serrations on machined weld edges shall be ground by burr wheel.
- iv) Oil, grease, dust shall be cleaned by power brush.

Handling of Aluminum Component During Fabrication

Bending and Rolling

- i) While bending and rolling, the Aluminum component shall not come in direct contact with C.S rolls/die.
- ii) Ensure, the protective material like felt, thin SS sheet shall be provided on roll /die, while rolling or pressing the component to avoid direct contamination.
- iii) Incase of non feasibility of protection, the component shall be passivated immediately after the rolling/bending.
- iv) To avoid excessive work hardening, bending/pressing shall be carried slowly (With gradual rise in the pressure).

Cleaning Technique

- i) Weld joint /back gouged weld shall be cleaned and dried before welding to avoid defect like porosity. This is to remove oil/grease/ dirt.
- ii) Ensure that grease/oily volatile material on the surface shall be cleaned by solvent like CTC and then after wire brushed. This is to avoid smearing of oil in the pores of Aluminum weld joint.
- iii) Ensure that chlorinated solvents are not used for **cleaning** oil/grease.
- iv) Ensure that all temporary /permanent supports, backing should be thoroughly cleaned and wire brushed before welding.

Handling of Aluminum Component During Fabrication

Preheating

- i) Surrounding area of 75mm each side of the weld joint/ Back gouged area shall be preheated to full thickness as per WPS to remove moisture to avoid porosity (Preheating temperature should be 75C min-120C max) and not longer than 30 minutes. (Excessive time and temp. shall affect the properties).
- ii) Check the preheat temperature by calibrated contact thermometer /temper stick

Wire Brushing

- i) Ensure Wire brushing by manual/ power brush just before starting the welding (This removes the aluminum oxide film).
- ii) Ensure that the identified SS bristles wire brushes are used for cleaning the weld joint.

Interpass Cleaning operation

- i) Ensure wire brushing/cleaning after each pass to remove the Smut and Oxide film on weld.

Handling of Aluminum Component During Fabrication

Back Gouging

- i) Gouging should be carried by using Rotary cutter without lubricant. (MIG / TIG welding process calls for back gouging of root weld.)

Weld backing

- i) Weld Joint with Zero root opening is recommended when temporary backing is provided.
- ii) Temporary backing may be of Copper, aluminum with hard anodized surface and sometimes with ceramic backing. This is incorporated to have fast cooling of weld.
- iii) In case of permanent backing, it shall be of aluminum and of same grade as that of base material.

Fixturing

- i) Ensure proper fixturing of the component to avoid distortion during welding.
- ii) Ensure that the component shall be held tightly enough for correct alignment and yet with out enough restraint to avoid weld crack.
- iii) Ensure that fixturing is not obscure for welder, welding arc and weld pool.

Handling of Aluminum Component During Fabrication

Tack welding

- i) Tack weld is usually welded over to become part of the weld. Hence it shall be welded with all precaution same as regular joint weld.
- ii) Tack weld shall be of small cross section and well penetrated.
- iii) In case of stronger tack requirement, it should be longer and closely spaced.
- iv) Ensure that all tack welds are properly dresses by grinding. And blend the ends in joint surface.

Distortion Control

- i) High coefficient of expansion with localized heat concentration during welding causes the distortion.
- ii) Following recommendations are made to reduce the distortion.
 - Use of optimum passes of weld.
 - Start the weld from neutral axes of members.
 - Select the welding process having
High welding speed, Possibility to weld in few passes &
Make the weld in narrowest possible groove.
 - Use fixture to pre-stress the component and maintain alignment during welding and control contraction during cooling.

Handling of Aluminum Component During Fabrication

Repair of Welds

- i) Weld defects shall be properly analysed and its location shall be identified.
- ii) The defects shall be removed by Burr/Rotary wheel grinder.
- iii) Ensure complete removal of defects and the surface shall be made smooth.
- iv) Ensure that the gouged /ground groove is shallow to have proper access for welding.
- v) Ensure complete cleaning of the joint.
- vi) Use qualified WPS and welder for weld repair.
- vii) Ensure all the essential parameters as per WPS are being used during welding.

Handling of Aluminum Component During Fabrication

Welding Consumable Handling

- i) Aluminum welding consumables are to be stored separately in polythene bags. (There shall not be mixing with any other consumables).
- ii) Welding consumables shall be checked for its correct identification and physical condition after opening the box.
- iii) Continuous consumables such as bare wire shall be stored separately with proper identification in a polythene bag to avoid any contamination from dust, oil, and grease.
- iv) These consumables shall be issued to the welder against the proper requisition.
- v) Cut wire shall be cleaned by passivation just before the welding, to avoid oxidation of Al. filler. (Cleaned in hot Caustic solution).

Handling of Aluminum Component During Fabrication

Welding

- i) The welding of Aluminum should be carried with correct qualified WPS Parameters.
- ii) Only Qualified compatible welding consumables shall be used for welding.
- iii) Welder shall use cleaned filler during welding.
- iv) Aluminum component shall be welded with optimum Heat input. (Excessive Heat input causes reduction in strength).
- v) Heat input shall be controlled by Optimum qualified Current, Voltage and welding speed.
- vi) Interpass temperature shall be kept as per qualified WPS during welding.
- vii) Cleanliness during welding is very important factor from contamination of weld point of view i.e. Weld joint and its vicinity shall be cleaned and free from any oil, grease and dirt.
- viii) Weld joint surface shall be free from serration.
- ix) Preheating of aluminum joint shall be controlled as per WPS and shall not be more than 30 minutes (Excessive preheating will reduce the strength).
- x) Identified Temporary supports shall be clean and to be welded with respect to qualified WPS.
- xi) Qualified welder shall be used during fabrication.

Handling of Aluminum Component During Fabrication

- xii) Separately identified burr wheel, power wheel, wire brush shall be used for interpass cleaning of weld.
- xiii) Argon gas 99.98% pure, with qualified flow rate shall be used during GTAW and GMAW process.
- xiv) Ensure that the calibrated welding power sources are used.
- xv) Double Operator Welding technique (DOT) shall be carried out to avoid back gouging wherever possible.

Grinding

- i) Weld joint, weld reinforcement shall be ground by identified burr wheel or sander disc grinder.
- ii) No hammering is allowed to remove the temporary supports.
- iii) Use identified burr wheel for back gouging and defect removal.

Radiographic Test

- i) In case of radiographic test requirement of the weld, it shall be radiographed in accordance with ASTM E142. The quality level of inspection shall be 2-2T.