

## An Experimental Analysis to Reduce Cracks in Arc Welding in MS and SS 304 (L)

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### Abstract

cracks are very common welding defects .Cracks can be hot or cold cracks .Cracks can be reduced by various parameters keeping in mind. The various parameters are 1. Preheat 2.Interpass heating 3.Post weld heat treatment (PWHT) 4. Welding speed 5. Energy input 6. Thickness of joint 7. Stresses 8. High current 9. High carbon content. The aim of this experiment was to study different types of cracks formed during welding process and to reduce the cracking of SS 304 (L) and M.S in fillet joints when arc welded.Lstands for very low carbon content.

**Keywords-** improved or crack free welding joint, preheat and interpass temperature

### I. Introduction

Due to increased globalization and constant technological advancements the welding industry has gone through surplus changes The need for perfection in welding is also increasing day by day .The power sector , the defence sector , the real estate sector all require precise or crack free welding Welding is highly varied process , from gas welding , arc welding , TIG welding , MIG welding LB welding , EB welding SAW. Resistance welding . to many other variants the welding process is selected as per the source of supply and quality of weld needed Most of the arc welding equipments are high current and low voltage machine . Cracks in welding occur due to various parameters which are explained in detail in this paper but this paper focuses mainly on the experimental set up for SS 304(L) and M.S to have crack free joint

### II. Cracks

Cracks are one of the welding defects other than Undercut, Slag inclusion, Incomplete fusion and Porosity. Cracks can be classified into two categories  
1. HOT CRACK

#### 2. COLD CRACK

Hot cracks occur either in weld bead or Heat Affected Zone. A hot crack shows temper colors on inner surface due to oxide film formation.

##### 2.1 Factors promoting hot cracks

(A) High current –more current is required if electrical conductivity is high but this increases heat input.

(B)High welding speed and long arc length may lead to development of cracks.

(C) High carbon and nickel content

(D) Preheating

(E)Thickness of joint- more the thickness rapid the cooling more is the chance of hardening.

(F)High residual stresses

(G)Weld bead shape

Cold cracks are associated through three main factors and is delayed cracking which is least understood 2.2The factors responsible for the cold cracks are

(A)The presence of susceptible microstructure

(B) The presence of atomic hydrogen

(C)The presence of residual stresses

The initiation of cold cracks is mainly due to change in microstructures such as martensitic –ferrite interface,notches. The main source of hydrogen is the moisture present in electrode especially cellulosic electrode and the best way is to bake the electrode before welding.

##### 2.3 Types of cracks

(A) Reheat cracks – it is mainly focused in heat and corrosion resistant low alloy steel containing Cr and Mo Reheat cracking is almost exclusively restricted to creep resistant steels and must be considered very seriously for cracking Reheat cracking can be caused by the generation of excessive thermal stress during the post weld heat treatment.

(B) Lamellar cracking – it is characterized by the cracking that can occur in steel members beneath the weld especially due to low ductility and localized strains. The base metal gets separated due to shrinkage stress set up due to cooling. The low ductility is induced due to mechanical working

(C)Chevron cracking – chevron cracking or 45°cracking cracks traverse to the welding direction makes 45°to the weld axis observed in a longitudinal section perpendicular to the plane of plates

(D)Stress corrosion cracking – it is found in stainless steel due to caustic or chlorine contaminants

### III. Heat input measurement Q-

$$Q = \frac{k v i}{ss} \frac{60}{1000} \quad \text{in kj/mm}$$

K=1.0 for submerged arc welding

=0.8 for mig, mag, mma

SS= welding speed in mm/min

The required value can be obtained from AWS handbook.

### IV. Experimental set up

Two samples were taken and tested experimentally for cracks

1. M.S

2. AUSTENITIC STAINLESS STEEL SPECIMEN1

The sample of MS was 12mm thick and no preheating was done and no interpass heating was done .The welding was fillet weld and arc welding was done the result of the specimen saw non-significant defects and the weld was acceptable after radiographic test.

SPECIMEN 2 SS 304(L)

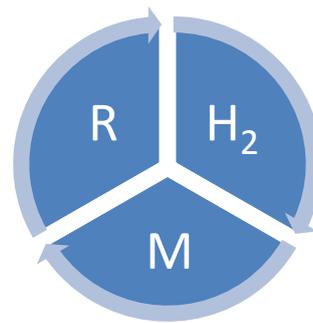
The second specimen was Austenitic Stainless Steel the sample had composition of 18/8 stainless steel with carbon content 0.025%..This structure makes the steel soft and nonmagnetic higher cooling rates are required to get the satisfactory mechanical properties preheating is not required and interpass temperature should not exceed 100°C

Keeping these views in mind 18/8 austenitic stainless steel of thickness 8mm selected and length of weld 50 mm was done No pre heating was done but the interpass temperature was selected to 60°C The number of interpass weld was three and the interpass heating was done with the help of oxyacetylene flame and the temperature was measured with the help of temperaturegun The result of radiographic test was that the specimen 2 had no significant defect and the welding was acceptable

### V. Conclusions

No preheating and no interpass temperature was provided in specimen 1 The specimen 1 had very less carbon content so due to low carbon equivalent no preheating was required, the low carbon content ruled out the possibility of martensite formation so no interpass temperature was provided. In specimen2 the high nickel and chrome content suppressed the transformation keeping material fully austenite on cooling. The nickel maintains the austenite phase and

Chrome suppresses the transformation. The carbide formation tendency at higher temperatures was retarded by lowering the interpass temperature to 60°C.In short the factors responsible for cold cracking shown diagrammatically as below



H<sub>2</sub>= HYDROGEN CONTENT IN THE WELD METAL

M = MARTENSITE FORMATION

R= RESIDUAL STRESSES

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