# Article

# Optimization of Welding Process Bead Geometry in Gas Metal Arc Welding Process Using Response Surface Methodology

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## Abstract

Automatic and robotic welding system is now used in a day to maintain their quality and productivity leads to an important role in terms of the fabrication industry. And it also helps them skilled welders, lack of health and safety needs, such as trying to get out of trouble. This type of system is used more. It is the correct method and parameters, which are very essential to choose how to satisfy the required weld bead. Casting all the different variables to be accepted an amendment to a high-quality, so this article, we will be rolling corrective accepted all the different variables have focused on high-quality.

**Keywords:** Robotic, Gas metal arc welding

## Introduction

Modern industrial products, which gives prosperity to mankind, and cast them to the proper conduct of the extension, which now join metals permanently and universally accepted method of efficiently and economically due to the monolithic structure.

Even rising progressively to lessen the cost of living has been improved and engineering material. Gas metal are welding (GMAW) covering lengthily winning quality stainless steel and have dressed her reflection mode is engaged. Remote steel true that they are relatively economically mass-produced in large quantities need to be very accurate and motorized features may have a wide range of reasons, the most widely used and resources primarily welded.

## Surfacing or Coating

On the base metal of the outer metal surface of a metal refers to the process of putting that in order to have the necessary dimensional (worn part of the back), or the Type of protection to wear, impact, or corrosion properties such as surface notify realized. The main aim behind hand costs for both the state and the exclusive metal wounded and to take a substantial drop is to save money. Initially, the process was running up a fresh part of the creation process, additional repairs cannot be found, but today it is quite satisfactory, and the useful tools for surface becomes.

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## Mig Welding

Mig welding aluminum and stainless steels mostly inert gas welding is used for welding older. These methods, pressure are formed between an electrode and a job. Where is the minor diameter of the electrode, which is plaster metal and hence offers no additional fields in a simple wire, is essential Shielding g argon, helium, carbon dioxide and oxygen, both of these gases in an empty gas can order castoff as dirt, dust, metal oxides, etc., for the sake of atmospheric contaminants from the molten metal pool with a mix of other gases near the pressure being castoff. As a castoff from the $CO_2$ gas is the only defensive, the process is called $CO_2$ welding. Previously, argon and helium are used as shielding gases. The $CO_2$ from the panoptic is used, and the oxygen and $CO_2$ blasting with inert gasses are assorted.

## MIG Variables

Wire, welding gas welding drives and circumstances should be used for essential to the effective choice is selected in accordance with the request of our order. This is because an excessive impact on the limitations of having a good amount of eccentricity can be used to weld. Due to the large range of these issues does not support this intent, the primary modification of any of these restrictions will be considered as casting operation? So morality is taken out of this situation. Wire, gas welding and likely to drive suitable for welding must be used for the benefit of choice to select the request in accordance with our order. This is because a lot of the character of the limitations of the impact of even having a decent amount of use.

## Welding Voltage

It is clearly noted that the arc length is controlled by the voltage settings, as well as a certain range of the welding current at a specified pressure should be asked to maintain stability.

## NPD

NPD bead shape with a pipe and a vigorous part of the continuing value. This is critical, because it is very small compared to the NPD, but when it gets too heating NPD too long, the pressure to increase the efficiency of shielding gases that are affected, including the possibility of extinguishing the gas will damage the nozzle. Normally nozzle to plate distance should be approx. 1 to 1.5 the inner diameter of the nozzle being used. .

## Welding Speed

Linear welding speed can be defined as the rate of the work piece, which moves along with the pressure. These parameters are mainly expressed in inches or meters per minute. Three statements are being made in connection with the welding speed.

1.  If an increase in the thickness of the material, and to bow down to the casting speed.
2.  The high-pressure molding of travel speed is achieved by using an economical method.

## Electrode Stick Out

The distance from the tip of the tip of the wire electrode contacts the bottom of the tube is known as the electrode stick out. It is an important parameter for controlling the decomposition rate and bead geometry. They stick out the transfer of another 16 to 25 mm; 5 to 15 mm for the transformer is put into short circuiting.

## Literature Review

Properties of ASS clad layer is of prime importance for the fabrication of equipment's, MREI - Rittinger HJ, 1988 austenitic stainless steel cladding layer has worked on factors affecting toughness. Both the weld geometry and chemistry drop test was carried out to study the effects of welding variables. The test results revealed that the solidification cladding layer pattern, chemical and phase composition can secure his freedom from solidification cracking. Embrittlement PWHT temperature clad layer solidification to improve the segregation of alloying elements and the reduced influence of magnetic materials and morphology can be overcome.

MiG-clad method is convenient when only a small surface of the material to be cladded, where S is uneconomical.

In 1988, Gautam DK/Breazu M [11] Past and current, voltage, welding speed and pulse frequency welding bead on the geometry of the weld parameters such as impact analysis. For the MiG-dressed, well result in low frequency (25Hz) can be achieved by using the pulse pressure. Conservative strategy is to use single layer when casting process should be avoided. Dressed in special cases, the weld deposit for the million and N is a need for a higher content of at least 30% more than the content of the buffer layer with a wire and thus is not available techniques should be applied.

In 2008, Benyounis KY and Olabi AG optimization methods covered in this survey, modeling, control and perfect fit for a variety of welding processes. Survey response (s) to predict and optimize the welding process and Ann's adaptation RSM expressed a high level of interest. Generally, there is a given that, according to the optimization problem in which the system performance optimization methods, in other words, a lack of comparative studies. Two optimization techniques, such as RSM,, GA, and combining the optimal welding conditions in order to better results. In the future the process of working on a specific welding process is safe, environmentally friendly and economically optimal welding adjustment can be considered to find out the modeling and optimization techniques should focus on implementation.

In 1995, Avery RE, Parsons D [12] wearing a practical application of cryogenic vessels worked ass. The storage vessels and other equipment or mechanical properties of the mechanical properties of donkey's and see any tendency for degradation and the crack to propagate and F-3200 above without any significant temperature can be maintained for a 9% Ni weld cladding corrosion used in the hips. The author results and longer service life compared to the hardness of which 20 years later is not expected to decline below the minimum code suggests. Duplex stainless steel welding processes used for wearing on the application has not been studied in detail.

## Present Work

As we study the literature, which already has enough points in that we have taken for research the following have been mentioned.

1. Wearing properties have been significantly affected by dilution comes out as a result. Therefore, when dilution control surface plays an important role too in a weak dilution. Finally, the composition of deposits comes closer to filling material dilution is quite low, and hence it is better dressed and corrosion resistant properties.
2. The GMAW process, the researchers tried to optimize the use of stainless steel cladding of the dilution. While doing so, found that the optimum conditions of the dilution is achieved, thus decreasing productivity of the process if it can be used for surfacing operations.
3. This progress is necessary for the operation of high deposition rates dressed, but it has been established that the deposition rate is achieved through a mix parameter.

As discussed above, based on the formulation of the problem, the following objectives have been formulated:

1. 304 stainless steel with mild steel plate of the electrode surface throughout the experimental models to improve the parameters of GMAW.
2. The use of low attenuation D-optimal design for optimum welding conditions is out of the invention.

## Methodology

RSM has been designated the following objectives (a common response surface method) method showed a small amount of the claim, and it's experimentations design surrounded tough to tackle factors to accomplish. The objective is to meet the basic need:

### Data Collection

RSM design matrix design is based on the rendering matrix. Experimentations on mild steel plate will be directed not only consuming 304 stainless steel electrodes.

### Empirical Modeling

A new experimental model designed using regression analysis (GMAW response and the relationship between the parameters of GMAW).

Visit a prototypical significance, in terms of the model synthesis using ANOVA analysis: development of models for the adequacy test. The empirical model GMAW parameters to be optimized to accommodate the store.

### Optimization of GMAW Parameters

Designed to satisfy the test methods, such as by literature survey, using contemporary techniques RSM optimization techniques best suited for the job is found. I nozzle plate distance, open circuit voltage, welding speed and wire feed rate as the numerical factors are being taken to identify for my current job. This design is in accordance with the matrix applied to the central rotatable design. 9.3.0 statistical software design specialist, the numerical coefficients decisive handling checking ANOVA, using numerical optimization models and generating output variables related to contracts for the Graph/feedback being used for. Designed to satisfy the test methods such as literature survey, RSM techniques best suited for the job using the current optimization techniques have been found.

## The following objectives of the issues discussed above are based on published or were framed:

1. Parametric optimization of parameters to determine the geometry of the bead, the bead height

2. Bead geometry infiltration bid.

## Experimentation

Additional consumables including, the base material and equipment used for the purposes of this chapter deals with a detailed examination.

## Materials and Equipment's Used

### Base Material

We 300x 100x 10 mm, which is the size of the impact of the block after using hacksaw was used as a physical layer for wearing flats that are filtered out using 8 mm thickness of mild steel plate.

### Filler Wire

304 austenitic stainless steel with a diameter of 1.2 mm is used for solid wire portrait. 304 physical and chemical self-ass types are as follows:

**Table 1.Chemical Composition of the Solid Wire 304**

| Material | C | Mn | S | P | Si | CU | Ni |
|----------|--------|--------|---------|--------|--------|--------|--------|
| % | 0.0195 | 1.7153 | 0.00086 | 0.0282 | 0.2884 | 0.1731 | 9.1355 |

| Ti | Cr | Mb | V | Tu | Al | Fe |
|------|---------|--------|--------|-------|-------|--------|
| 0.04 | 19.2703 | 0.0776 | 0.1189 | 0.036 | 0.006 | 68.923 |

**Table 2.Composition of the Base Metal Plate M.S. being Used (wt %)**

| Material | C | Si | Mn | P | S | Ni | Cr | Al | Fe |
|----------|------|------|------|-------|-------|-------|-------|-------|---------|
| M.S. | 0.13 | 0.16 | 0.58 | 0.024 | 0.021 | 0.020 | 0.043 | 0.027 | Balance |

## Shielding Gas

The test used was pure argon shielding gas technology. Shielding gas pressure kept constant for each experimental run 22Lt/min is stored in.

## Experimental Set up for Thesis

The comprehensive experimental setup is shown in the Fig. 1 below:



**Figure 1.Set up of Robotic MIG Machine**



**Figure 2.Work Piece (Bead Slide)**

## Experimental Parameter

Austenitic stainless steel cladded plate and a complete knowledge about the reliability of the following terms and conditions will be imperative to investigate.

1. Identification, selection and the establishment of parameter ranges.
2. The current welding, weld bead geometry, thinning, deposition rate and index RSM methods dressed out for the optimum welding conditions.
3. Micro hardness testing and bend tests to assess the properties of claddings.

## Results

Automatic and robotic welding systems, in modern times, in terms of maintaining their quality and productivity leads to an important role for the fabrication industry. And it also helps them skilled welders, lack of health and safety needs, such as trying to get out of trouble. This type of system is used more. It is the correct method and parameters, which are very essential to choose how to satisfy the required weld bead. Casting all the different variables to be of a high quality to get an amendment accepted. Mathematical modeling can be applied to the investigation of the fields due to a variety of research on this method, faster, versatile and economical use of the weld bead weld on the symmetry of the magnitude of the impact of the variables are taken to accomplish this goal. Advanced mathematical models and equations, in which the data is being represented in the program and fed to the computer specialist welding system is being developed. After these process variables welding and weld bead geometry of the final mathematical model was used to show the relationship between the graphically. Finally, optimize welding parameters using the RSM, is obtained by achieving good quality weld claddings.

Central composite rotatable design, which is based on a statistical technique or a combination of these models, should be developed appointed to conduct the examination. The design of this type of test weld bead geometry and mathematical models to predict and coefficients adequacies significance for developing mathematical models for the procedure for the examination procedures are covered in this chapter. It is the correct method and parameters, which will satisfy the chose to weld bead is very essential. Casting all the different variables to be of a high quality to get an amendment accepted.

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## Design of Experiments

This test, which helps them deal with the complexities of an important tool for technical investigations. Information in the form of a systematic approach to data collection works as. This is essential to the design and the requirements set by the expert precision sufficient to solve the problem in terms of the number of trials and selection process to run them. My current research experimental methods are being used to guide the design of the multiples. This method of statistical design of experiments technique for engineering investigation is recommended as one of the best methods. This is related to the concept of technology is explained below.

This approach is based on quantitative research techniques are being used for the test design technique is considered to be one of the best. My current research experimental methods are being used to guide the design of the multiples. This method of statistical design of experiments technique for engineering investigation is recommended as one of the best methods. This is related to the concept of technology is explained below.

### Factor

One independent variable is called a factor which can be set to the desired value. Factors investigational pseudo scientist run time is controlled by the right. Quantitative numerical values and the effect of electrode polarity or qualitative factors such as the type of shielding gas there.

### Level

This is not a mathematical value or qualitative features of each factor. Run time is a factor in the neck and throat untested or setting its value.

### Treatment

Levels, each factor, which has been verified in a specific group, called the group.

### Response

It's a combination of specific treatments made with the mathematical results of a comment.

## Central Composite Rotatable Design

Cochran and Cox has developed a new project, which is definitely fitting the second order response surface factorial 2k is assembled by adding about further treatment from the rotatable center for the complex designs. As a result, the overall number of treatments can be reduced by employing a combination of these designs.

## Factors and their Levels

The various factors and their levels are given in Table 3.

## Development of Design Matrix

Design Matrix two variable factors, which could not be developed for bead geometry for the calculation explained. The experimental learning in a variety of input variables and comebacks are as follows:

## Input Variables

Open circuit voltage (V), Wire feed rate (F), Welding speed (S) and Nozzle to plate distance (N) is being used.

## Response Parameters

Bead height (h)**,** Depth of penetration (p)

## Process of the Checking of Archetypal Adequacy

## The Analysis of Variance Test for Regression (ANOVA)

Under this method and the results of the analysis of data that is being analyzed after being displayed in tabular form. Hence the table is also known as the analysis of variance table. This is a unique source of information on the measures of variance table represents information summer.

## Optimization

As well as the response to the needs of each of the factors, this coincidently levels of optimization factors to justify the process of coordinating the searches. Before it gets optimized model is being set up to provide the appropriate response. Coincidently a single reaction or response numerically or graphically, including reaction optimization can be.

## Numerical Optimization

Numerical optimization is a process, and each response factor is selected for the desired goal. The aim to minimize, maximize, was the destination. Under range (only for feedback) and a proper standard (just because) of the set up. Every parameter has been provided for the highest and lowest levels. Compared to other goals will be changed about the necessity of every goal. Maximize the function of a complete elegance function is closed. And the steepest slope starts random target seeking forward to.

## Analysis of Numerical Optimization

In response to such optimization, Weld bead geometry, and the weld bead penetration levels, 9.3.0 software is used to design specialist. Optimization results desired in the form of ramp, which gives up to solve a variety of input parameters, such as reaction with a variety of settings by setting a target value is obtained.

## Conclusion

The following conclusions are as follows:

1. With the increase in the wire feed rate, depth of penetration will increase.
2. The wire feed rate increases; it also increases the rate of the weld bead. Open circuit voltage and the distance between the nozzle plate, but the welding speed is reduced.
3. A five level of four-factor factorial central composite rotatable design approach based on the mathematical model of the matrix can be used to predict the development.
4. Four process variables, wire feed rate is considered the most important and influential factor was having a positive impact on the outside.
5. The impact NPD, welding speed, wire feed rate of penetration for OCV and "PROB.> F" value of less than 0.05, indicating that the surface roughness was found to be a significant impact on them.

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