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National
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Participant Handbook

Sector
Iron & Steel

Sub-Sector
Mechanical Maintenance

Occupation
Cutting and Welding

Reference ID: **ISC/Q0910, Version 1.0**
NSQF Level 4

Plasma Cutter (Manual)

Published by

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Disclaimer

"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

Certificate

COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

Indian Iron & Steel Sector Skill Council

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/ Qualification Pack: **'Plasma Cutter-Manual'** QP No. **'ISC/Q0910 NSQF Level 4'**

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About this book

This Participant Handbook is designed to enable training for the specific Qualification Pack(QP). Each National Occupational (NOS) is covered across Unit/s.

The job is all about cutting different materials (mild carbon steel, stainless steel, aluminium, high tensile and special steels, and other materials) in various profiles. This involves setting-up and preparing for operations interpreting the right information from the specification documents, obtaining the right consumables and other materials, etc.

Key Learning Objectives for the specific NOS mark the beginning of the Unit/s for that NOS. The symbols used in this book are described below.

Symbols Used


Key Learning Outcomes


Steps


Exercise


Tips


Notes


Unit Objectives

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Key Learning Outcomes

At the end of this module, you will be able to:

1. Know about plasma arc cutting process
2. Know about different parameters of plasma arc cutting
3. Know about equipments used in plasma arc cutting
4. Know about setup and operation of plasma arc cutting
5. Know about plasma arc cutting techniques
6. Know about quality check and inspection of cutting
7. Know about safety precautions during plasma arc cutting

UNIT 5.1: Plasma arc cutting

Unit Objectives

At the end of this unit, you will be able to:

1. Know about plasma arc cutting
2. Know about fundamental process of plasma arc cutting

5.1.1 Plasma arc cutting

Definition of Plasma

Plasma is an electrically conductive gas. Ionization of gases causes the formation of free electrons and positive ions in the atoms of gas. Because of this, the gas becomes electrically conductive having current carrying capabilities and becomes plasma.

Plasma in Nature

Natural lightning is an example of plasma. The lightning moves electricity naturally similarly like using a plasma torch.

Fig 5.1.1 Plasma arc

Plasma arc cutting

- By plasma arc cutting method, precise cutting can be done in stainless steel and non-ferrous metals like aluminium.
- High speed and temperature gas jet is required for generating an arc between electrode and component for cutting.
- First arc heat melts the metal and after that gas high speed flow cleans the molten metal

from the cut.

- Arc works in an inert inner shield.
- Mixture of argon, helium or nitrogen is used for inner and outer shielding.
- Plasma arc cutting method is mostly utilized in mechanized systems.

Uses/applications of plasma arc cutting:

(i) In tube mill application.

(ii) Welding of cryogenic, aerospace and high temperature corrosion resistant alloys.

(iii) Nuclear submarine pipe system.

(iv) Welding steel Rocket motor case.

(v) Welding of stainless steel tubes.

(vi) Welding titanium plates up to 8mm thickness.

Advantages

(i) small risk of changing the shape of the metal (called distortion)

(ii) precise cutting

(iii) slag-free cuts when working with aluminum, stainless steel and carbon steel

(iv) works in all positions

(v) fast process

(vi) works across many types of metals

(vii) do not require gas cylinders

Disadvantages

(i) creates a small bevel

(ii) electrical shock risk when not operating safely

(iii) requires clean air source

(iv) needs electricity to operate so not completely portable

(v) not cost effective for very thick steel

5.1.2 Plasma arc cutting fundamental process

The basic fundamental process of plasma arc cutting is first formation of arc between electrode and workpiece by a copper nozzle. After that, temperature and velocity of the plasma will increase which is originating from nozzle. At that time, plasma temperature is more than 20,000°C and speed is near to the speed of sound. To start cutting, flow of plasma gas is increased, and then it starts penetrating the workpiece deeply and cleans the molten metal by plasma jet.

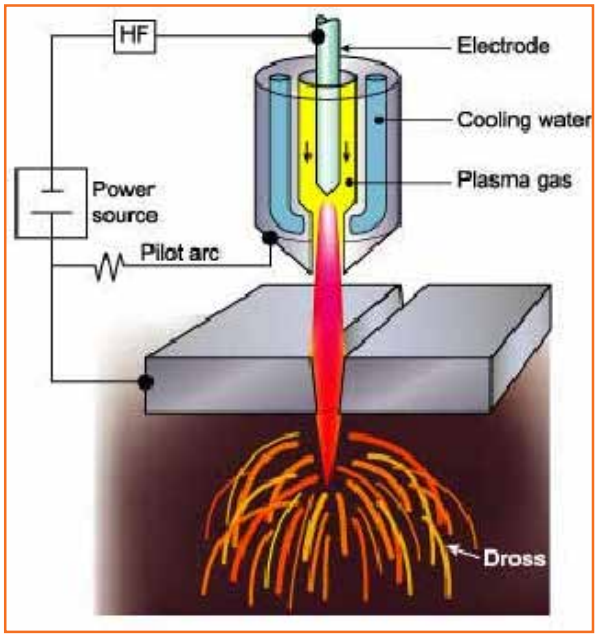

Fig 5.1.2 Plasma arc cutting

Plasma arc process is different from oxy-fuel process. In plasma process an arc is required to melt the metal while in oxy-fuel method, oxygen oxidizes the metal and the heat generated melts the metal.

5.1.3 Metals cut by plasma arc process

The metals usually cut with this process are the aluminum and stainless steel. This process is also used for cutting most iron free metals (non-ferrous) as well as: aluminum, brass, carbon steels, cast iron, copper alloys, copper, high nickel, magnesium, mild steel, nickel alloys, stainless steel.

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