Laboratory Manual
MANUFACTURING TECHNOLOGY LABORATORY (MTI-191)

Title of the Experiment: Gas Metal Arc Welding (GMAW).

1. Aim of the Experiment: To measure metal deposition rate at various welding conditions and determine corresponding mechanical and metallurgical properties.

2. Performance Objective:

- Compare this process with other arc welding methods and judge its applicability.
- Establish the electrode feed rate with respect to current and voltage.
- Analyse the impact of the shielding gas used during welding.

3. Theory

In gas metal-arc welding (GMAW), the weld area is shielded by an effectively inert atmosphere of argon, helium, carbon dioxide, or various other gas mixtures. The consumable bare wire is fed automatically through a nozzle into the weld arc by a wire-feed drive motor. In addition to using inert shielding gases, deoxidizers usually are present in the electrode metal itself in order to prevent oxidation of the molten-weld puddle. Multiple-weld layers can be deposited at the joint. Metal can be transferred by three methods in the GMAW process:

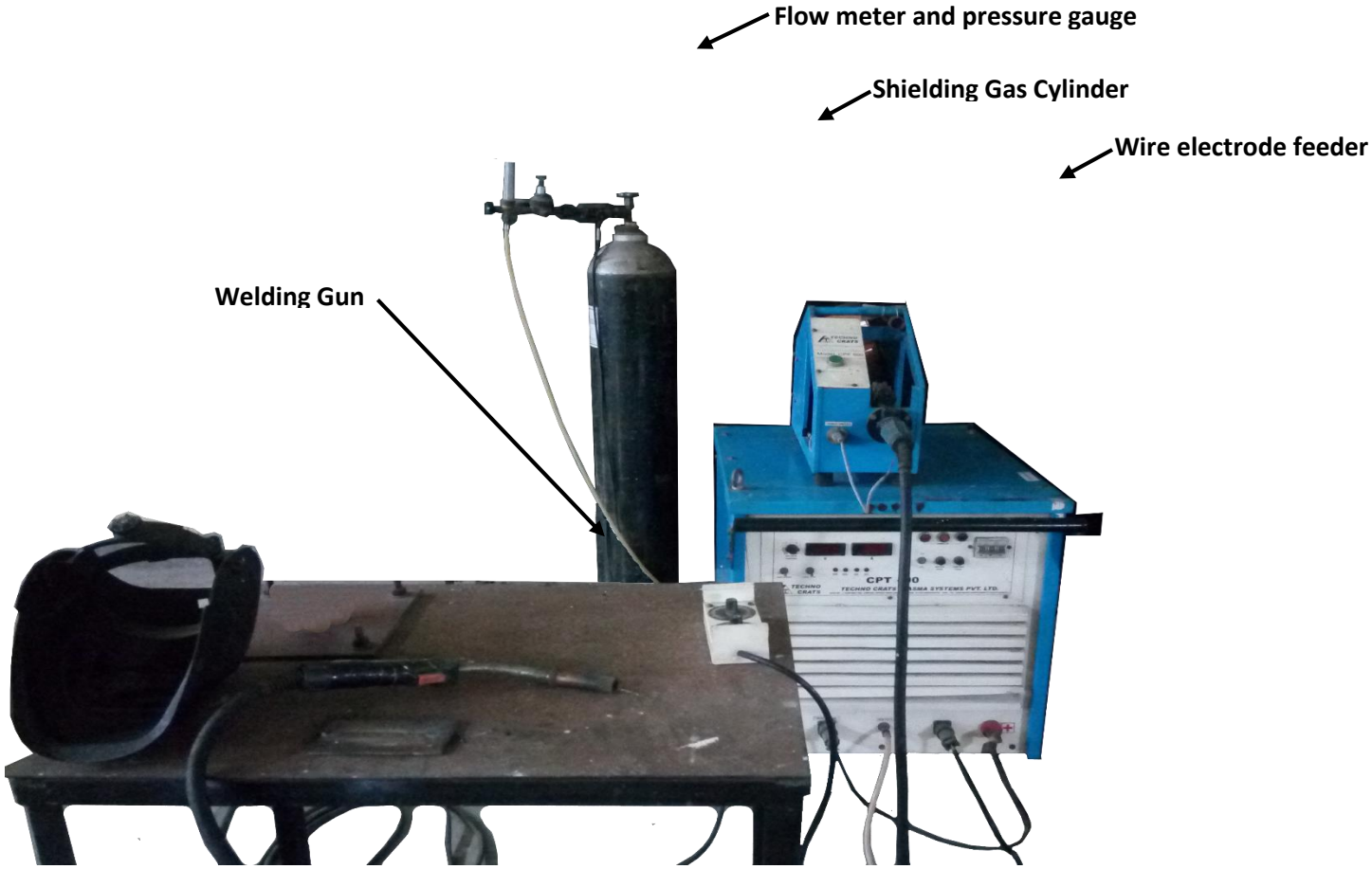
1. In spray transfer, small, molten metal droplets from the electrode are transferred to the weld area at a rate of several hundred droplets per second. The transfer is spatter free and very stable. High DC currents and voltages and large-diameter electrodes are used with argon or an argon-rich gas mixture as the shielding gas. The average current required in this process can be reduced with the use of a pulsed arc, which superimposes high-amplitude pulses onto a low, steady current. The process can be used in all welding positions.

2. In globular transfer, carbon-dioxide-rich gases are utilized, and globules are propelled by the forces of the electric-arc transfer of the metal, resulting in considerable spatter. High welding currents are used, making it possible for greater weld penetration and higher welding speed than are achieved in spray transfer. Heavier sections commonly are joined by this method.

3. In short circuiting, the metal is transferred in individual droplets (more than 50 per second) as the electrode tip touches the molten weld metal and short-circuits. Low currents and voltages are utilized with carbon-dioxide-rich gases and electrodes made of small-diameter wire. The power required is about 2 kW. The temperatures generated in GMAW are relatively low; consequently, this method is suitable only for thin sheets and sections of less than 6 mm (0.25 in.); otherwise incomplete fusion may occur. The operation, which is easy to perform, is commonly used for welding ferrous metals in thin sections. Pulsed-arc systems are used for thin ferrous and nonferrous metals.

The GMAW process is suitable for welding most ferrous and nonferrous metals and is used extensively in the metal-fabrication industry. Because of the relatively simple nature of the process, the training of operators is easy. The process is versatile, rapid, and economical, and welding productivity is double that of the SMAW process. The GMAW process can be automated easily and lends itself readily to robotics and to flexible manufacturing systems.

3.1 Equipment Used
Model: CPT-400
Welding Current: 400 Amps.
Max. Welding Current at
60% duty cycle: 400 Amps.
100% duty cycle: 310 Amps.
Open circuit Voltage: 15-55 V DC
Transformer Cooling: Forced Air
Input Connection: 3 phase



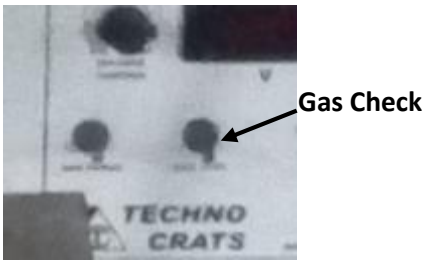
WIRE FEEDER
Model: CPF600
Driver: 4 Roll quick Release
Wire Diameter: 0.8, 1.2, 1.6
Wire Feed speed: 1.2 to 18.5m/min.

3.2 Specimens to be welded:

Give material specification and give joint preparation detail if any.
Give specification of the filler material used.

4. Procedure

- First check the power connections and polarity. GMAW has to be performed in DCRP always.
- Fit the wire electrode from the feeder to welding gun.
- Release the control valve on the cylinder to turn on gas supply to machine.
- Turn on the power and press the gas check toggle switch to check the gas flow through the gun.
- Check the three phase line indicator and open circuit voltage.
- Now set operating parameters on the remote control panel.
- Hold the welding gun in appropriate orientation and perform the welding while pressing the switch available on the gun.



4.1 Precautions

- Before starting the welding check flow of shielding gas.
- Perform a dry run on a dummy plate to check arc characteristics.
- The bare electrode must be free of any irregularities and rust.
- Always perform edge preparation and face matching.

7. References

1. Kalpakjian, S.; Steven, R. S. Manufacturing Engineering and Technology; Prentice Hall: New Jersey, 2010; 6th ed.

2. ASM Handbook: Vol. 9 Metallography and Microstructures; Materials Park, OH: ASM International, 2004

3. Title: GMAW Welding Best overview, Author: Chetan Sing, Publisher: Independently published.

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