

Argon Arc Welding

Safety Operation Guide

Argon Arc Welding

Definition

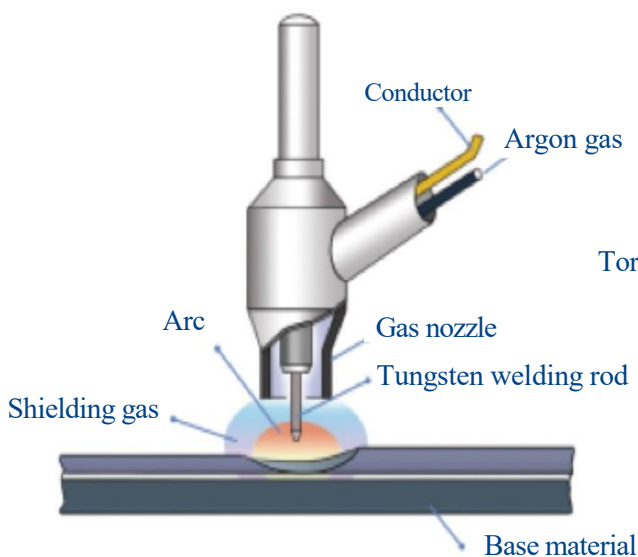
This welding method uses argon inert gas (Ar) as a shielding gas to prevent oxidation of the weld area where the electric arc is generated during welding. The arc heat generated between the non-consumable tungsten electrode and the base material melts the base material to join them.

Characteristic

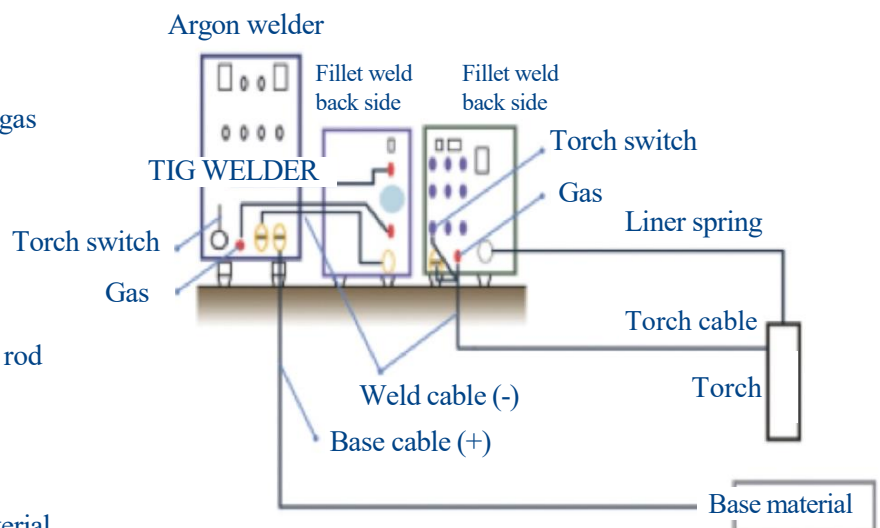
Argon gas (molecular weight 39.95) is heavier than air and has the property of lingering on the ground.

Hazard

The risk of asphyxiation is high due to argon gas. The arc strength generated during welding is stronger than that of standard welders, which can cause burns to the eyes as well as any exposed parts of the body.



Argon welding schematic



External connection of the argon welder

1 Major Hazards

✓ Asphyxiation hazard

- Risk of asphyxiation if argon gas, which is heavier than air, leaks in poorly ventilated or enclosed spaces

✓ Fall hazard

- Risk of falling while moving or working near fall hazard areas in the welding zone

✓ Electric shock hazard

- Risk of electric shock due to work conditions (e.g., incomplete grounding, damaged wires, or wet conditions).

✓ Injury hazard

- Risk of bodily injury and burns from the arc light, spatter*, and slag*.

*Spatter: Metal fragments generated during welding, *Slag: Non-metallic material formed during welding

2 Key Inspections

Piping transportation	<ul style="list-style-type: none"> • Proper condition of fiber ropes used for material transportation during welding • Control of access in heavy object transportation areas • Appropriate fall protection measures near fall hazard areas in pipe installation sites
Argon purge	<ul style="list-style-type: none"> • Development and implementation of confined space work programs • Correct work methods and hazards related to confined space work for workers • Use of air respiratory devices (e.g., supply masks) and preparation of escape equipment (e.g., ladders) • Leak checks, oxygen concentration, and hazardous gas concentration measurements before work • Adequate ventilation (e.g., supply and exhaust)
Piping welding	<ul style="list-style-type: none"> • Proper protective equipment (e.g., welding helmets, dust masks, protective clothing, safety shoes) • Grounding of welding power supplies, base materials, and electrically connected jigs • Separation of flammable materials, explosive substances, etc., from welding areas • Installation of fire prevention measures (e.g., fire blankets) and provision of fire extinguishers during welding
Nondestructive testing	<ul style="list-style-type: none"> • Blocking and separating argon gas after argon welding • Removal of residual gas inside pipes (forced ventilation) before checking beads inside the pipes • Measurement of oxygen concentration and residual gas after removing internal residual gases

3 Risk Assessment (Example)

Hazards	Measures	Rules on Occupational Safety and Health Standards
Risk of collision when transporting pipes using a crane	<ul style="list-style-type: none"> . Assign signalers along the transport route and restrict worker access when transporting pipes and other welding materials using a crane. . Attach guide ropes when transporting heavy objects. . Crane operators must follow signals while operating. 	Article 146
Risk of falling due to breakage or slipping of fiber ropes during pipe transportation	<ul style="list-style-type: none"> . Before use, inspect fiber ropes and replace any that are frayed, severely damaged, or corroded. . Keep fiber ropes dry and protected from water, oil, and other contaminants. 	Article 169
Risk of falling due to the absence or improper fixation of covers for openings in the walkway floor for welding	<ul style="list-style-type: none"> . Install covers of appropriate size for openings. . Ensure the covers fully cover the openings and are securely fixed to prevent tipping or displacement. . If installing a cover is not feasible due to work inside the opening, implement fall protection measures (e.g., safety railings) and ensure the opening is marked and visible even in dark areas. 	Article 43
Risk of falling from openings, such as pipe ends and block edges, during welding	<ul style="list-style-type: none"> . Install safety railings at welding sites and other areas with fall hazards. . If installing railings is not feasible, set up anchor points for safety harnesses and ensure workers secure their harnesses while working. 	Article 42~Article 44
Risk of tripping over obstacles or colliding due to insufficient lighting when moving for internal and external pipe welding on blocks	<ul style="list-style-type: none"> . Install lighting inside blocks to ensure sufficient illumination. . In areas not regularly accessed, such as inside pipes, use portable lighting equipment to maintain adequate illumination (75 lux or more). 	Article 21

Hazards	Measures	Rules on Occupational Safety and Health Standards
<p>Risk of heat-related illnesses (e.g., heatstroke, heat exhaustion) due to prolonged exposure to hot and humid conditions during extreme heat periods</p>	<ul style="list-style-type: none"> . Provide adequate water and rest during work, and adjust workload and intensity according to heatwave levels. . Closely monitor high-risk groups (e.g., elderly workers and those with medical conditions) during extreme heat. . Set up rest facilities for workers. <div style="text-align: center; background-color: #cccccc; padding: 5px; margin: 10px 0;"> Installation and Management Standards for Rest Facilities </div> <ol style="list-style-type: none"> 1. The floor area must be 6 m² or larger. 2. The ceiling height must be 2.1 m or higher. 3. Round-trip travel time should be less than 20% of the break time. 4. Rest facilities: <ul style="list-style-type: none"> - Must be located away from the following areas: <ul style="list-style-type: none"> . Areas with fire, explosion, or other hazards . Areas where hazardous materials are handled . Areas with harmful dust or high noise levels, making rest difficult - Must have heating and cooling functions to maintain an appropriate temperature (18–28°C). - Must have humidity control to maintain an appropriate humidity level (50–55%). - Must have lighting control to maintain appropriate brightness (100–200 lux). <p><i>Source: KOSHA GUIDE "Technical Guidelines for Installing Worker Rest Facilities"</i></p>	<p>Article 566 , Article 567</p>
<p>Risk of asphyxiation due to accumulated argon gas inside pipes</p>	<ul style="list-style-type: none"> . Ensure adequate ventilation and check oxygen concentration before performing tasks inside pipes, such as RT inspections. 	
<p>Risk of asphyxiation from argon gas buildup during welding in inadequately ventilated pipes</p>	<ul style="list-style-type: none"> . Ensure adequate ventilation and check oxygen concentration before performing tasks inside pipes, such as RT inspections. . Check for gas leaks before argon gas welding. . Post access restrictions, work details, and worker information at the entrance of confined spaces. . Measure oxygen concentration before entering confined spaces and manage the number of personnel entering. . Maintain continuous ventilation during work inside confined spaces. <div style="text-align: center; background-color: #cccccc; padding: 5px; margin: 10px 0;"> Establishment and Implementation of Confined Space Work Programs </div> <ul style="list-style-type: none"> . Identify confined spaces within the workplace and develop management measures . Identify and manage hazards that could cause asphyxiation or poisoning within confined spaces . Verify necessary conditions before confined space work . Provide safety and health education and training . Prevent health hazards for workers performing tasks in confined spaces <p><i>Source: KOSHA GUIDE "Technical Guidelines for Establishing and Implementing Confined Space Work Programs"</i></p>	<p>Article 233, Article 619, Article 619-2, Article 620, Article 622</p>

Hazards	Measures	Rules on Occupational Safety and Health Standards
Risk of asphyxiation due to ventilation system malfunction or power failure during argon welding, preventing proper ventilation	. Measure the oxygen concentration in confined workspaces, and if the air quality is insufficient, immediately wear an air respirator or supply mask.	Article 619-2, Article 620, Article 622
Risk of asphyxiation when entering pipes to remove sponges for argon purging	. When removing sponges for argon purging inside pipes, use a towing rope. If unavoidable, ventilate the argon gas inside the pipe and supply fresh air before entering.	
Risk of health issues due to welding fumes and toxic gases during welding	. Ventilate the area with local exhaust systems to remove harmful gases, vapors, dust, etc., and wear appropriate protective equipment (e.g., dust masks, gas masks, air supply masks) for the task. *Wear an air supply mask in areas with asphyxiation risks, such as inside pipes.	Article 422 Article 450 Article 620
Risk of electric shock due to insulation damage in the control panels, electrical panels, or connections of electrical cables (e.g., terminal blocks, connectors)	• Implement electrical shock prevention measures by ensuring proper insulation and grounding of connection points (e.g., terminal blocks, connectors) inside control panels, electrical panels, and cables.	Article 301, Article 302
Risk of fire or explosion if welding sparks scatter onto nearby combustible materials, flammable liquids, or vapors	<ul style="list-style-type: none"> • Remove combustible materials or implement protective measures during hot work (e.g., welding). • Use welding or fire blankets to prevent sparks and slag from scattering. • Ensure proper ventilation to eliminate vapors and gases from flammable liquids (e.g., solvents) (note: do not use oxygen for ventilation). • Place fire extinguishing equipment in hot work areas and designate fire watch personnel to monitor the site. <div style="background-color: #cccccc; padding: 5px; text-align: center;">A fire watch should:</div> <ul style="list-style-type: none"> • Check for combustible materials in the work area; • Check the operation of gas detectors and alarm systems; • Guide workers to safety in the event of a fire. 	Article 232, Article 241, Article 241-2

[Reference] Selection of Protective Equipment Based on Work Areas

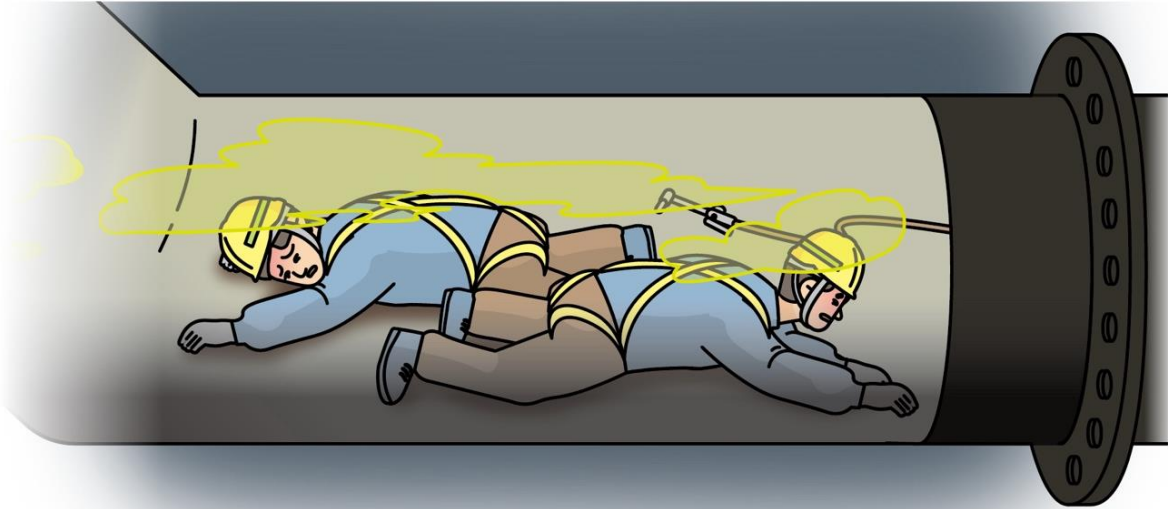
Areas where the oxygen concentration is less than 18%:	<ul style="list-style-type: none"> • Air supply masks or respirators *For poorly ventilated workspaces or confined space work
Areas where the oxygen concentration is 18% or higher:	<ul style="list-style-type: none"> • Dust masks: For work where dust, mist, fine particles, etc., are generated • Gas masks: For handling organic solvents, chemicals, etc. *Not suitable for use in confined space work.



Accident Case Asphyxiation inside pipe during argon welding

✓ Summary

A worker entered a pipe during argon welding and suffocated from the argon gas, resulting in death.



✓ Causes

■ Inadequate management of confined space work

- Work permits and access restrictions were not implemented for the confined space work.
- A monitor was not assigned outside the confined space.

■ Failure to ventilate and measure oxygen and hazardous gas concentration before working in the confined space

- The worker entered the confined space without measuring the oxygen concentration.
- Sufficient ventilation was not provided in the poorly ventilated area.

✓ Preventive Measures

■ Systematic management of confined space work

- Implement a work permit procedure for tasks with asphyxiation risks, such as argon welding.
- Designate and assign a monitor to control access to the area for individuals not involved in the work.

■ Measurement of oxygen and hazardous gases and ventilation before confined space work

- Measure the oxygen and hazardous gas concentrations before work and continuously monitor them.
- Ensure continuous ventilation to maintain air quality before and during confined space work.