

NEEL DIVING

ACADEMY

UNDERWATER WELDING INTRO
BY GILBERT V. ANTONY



INTRODUCTION

Underwater welding is a specialized technique used for joining metal structures in submerged environments, such as oceans, rivers, or lakes. It plays a crucial role in the maintenance and repair of offshore oil rigs, pipelines, marine vessels, bridges, and underwater habitats.

NEEL DIVING ACADEMY - Underwater Welding Certification Course First-of-its-kind certificate by the IRS and IIT Guwahati

Technology Innovation Hub (TIH), IIT Guwahati in collaboration with the Indian Register of Shipping (IRS), Mumbai, and Neel Diving Academy, Kochi has introduced a specialized Underwater Welding Certification Course, aiming to address the growing demand for skilled underwater welders. This course equips industry professionals and students with advanced knowledge and hands-on experience in wet welding, enhancing their proficiency in this highly specialized field. With a focus on safety, precision, and practical applications, the course is designed to meet industry standards for marine, offshore, and construction sectors.

Methods and Techniques

There are two principal types of underwater welding:

- **Wet Welding:** Performed directly underwater, with the welder and equipment fully submerged. The most common technique is Shielded Metal Arc Welding (SMAW), where an electric arc creates a gas bubble that protects the weld zone from water, but this method often suffers from rapid cooling, porosity, and lower weld quality. Wet welding is generally preferred for quick repairs and smaller jobs due to its simplicity and versatility.
- **Dry Welding (Hyperbaric Welding):** Uses a pressurized chamber filled with protective gases, allowing the welder to operate in a dry environment even at great depths. This method produces higher-quality welds by controlling atmospheric composition and temperature, but is more costly and complex. Dry welding is suitable for large-scale and critical projects



CHALLENGES AND RISKS

- Challenges and Risks
- Underwater welding is a demanding and hazardous profession. Welders face unique risks such as electrical hazards, compromised visibility, rapid weld cooling leading to cracking, and hydrogen embrittlement that can cause structural failure. Specialized training, certifications, and safety protocols are essential to manage these risks and protect both the welder and the environment.

What is commercial diving?

- Professional Diver working underwater for a pay. The most common work sites are Off-shore, In-shore and Harbour jobs.
- Off-shore – Oil & Gas industry, which is the highest pay divers get according to their certifications.
- In-shore – Underwater construction, Dredging, pipe laying etc.
- Harbour jobs – Underwater ship repairs, in-water surveys etc.

So what is a Commercial Diving and a Scuba Diving / Recreational Diving?

- As mentioned commercial divers get paid for the job they do.
- Recreational Diving is done for fun or entertainment by going underwater and enjoying the underwater life.
- The standard depth for Recreational Divers is -40 meters.

So what you call diving beyond -40 meter

- It's called Technical Diving. Technical Divers use different gas mix to breathe to avoid pressure related problems arises in human body.

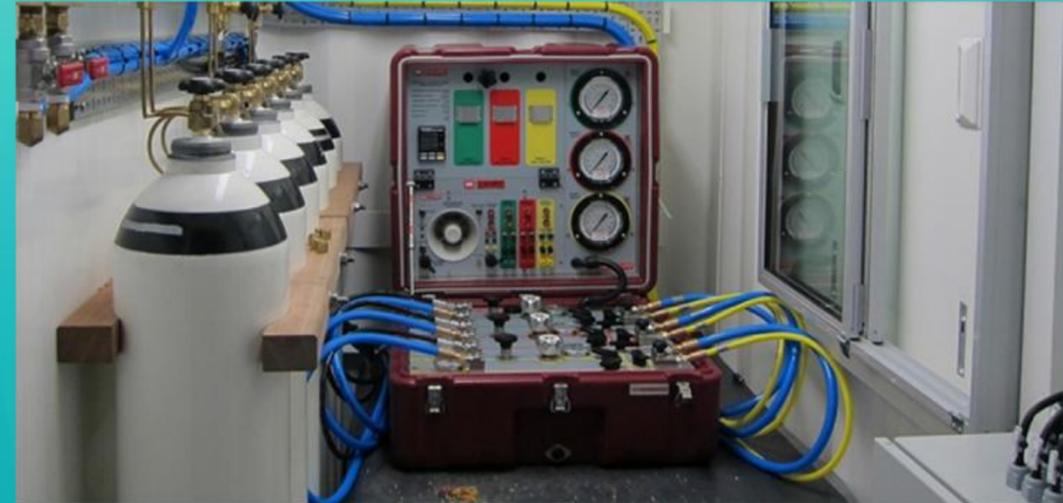
Is commercial diving and scuba diving equipment the same?

- In Commercial Diving, Divers use the Surface Supply equipment.



Commercial Diving equipment

- Surface supply equipment



Helmets

- Umbilical with KMB Helmet



Different types of Diving Helmet

- Different brands



Commercial Diving equipment

- KMB Band Mask



Commercial / Scuba/ PSD Full Face Mask

- Different Brands



APPLICATION

- This technique is vital for the maritime industry and underwater construction, allowing crucial repairs to be made without removing structures from water. Its efficiency has enabled large infrastructure projects and quick response to maintenance emergencies in submerged locations
- Underwater welding merges the skills of professional diving and advanced welding, making it both an exciting and essential field in marine engineering and infrastructure maintenance

Differences Overview

Aspect	Wet Underwater Welding	Dry Underwater Welding (Hyperbaric)
Welding Environment	Performed directly in water; fully submerged	Conducted inside a pressurized dry chamber (hyperbaric)
Equipment Needed	Waterproof electrodes; minimal additional equipment	Hyperbaric chamber, specialized gas mixtures, extensive gear
Weld Quality	Lower quality due to rapid cooling, porosity, cracking, poor visibility	Higher quality, better control, slower cooling
Safety	Higher risk of electric shock, visibility issues, hydrogen embrittlement	Lower risk, safer due to dry conditions
Cost and Setup	Less expensive, quick setup, ideal for emergency repairs	More costly, complex setup, best for critical/precision jobs
Mobility and Speed	Greater mobility, faster, suitable for hard-to-reach locations	Limited mobility, slower process
Typical Applications	Small, urgent repairs in the field	Large-scale, critical structure repairs under strict standards

Wet welding offers convenience, speed, and cost-effectiveness, but comes with increased risks and generally weaker, less reliable welds. Dry welding provides a controlled, safer environment for producing strong, high-quality welds, but requires more equipment, time, and financial investment

Compare weld quality and failure modes between wet and dry welding

Dry underwater welding produces far superior weld quality compared to wet welding, and their typical failure modes reflect these differences.

Weld Quality Comparison

Wet Welding: Welds are often of lower quality because the water environment causes rapid cooling, increased porosity, hydrogen embrittlement, and inconsistent arc stability. These issues lead to lower tensile strength, poor fatigue performance, and lack of fusion defects.

Dry Welding (Hyperbaric): Welds have greater strength, ductility, and reliability because they are performed in a controlled dry chamber with stable atmospheric conditions, allowing pre- and post-weld heat treatment and better visibility. This environment minimizes porosity and cracks, resulting in superior weld metal and joint performance.

Failure Modes

Weld Type	Main Failure Modes	Fatigue Performance	Typical Defects
Wet Welding	Fatigue cracking, brittle fracture, accelerated crack propagation	Poor; crack growth accelerated by porosity pmc.ncbi.nlm.nih	Porosity, lack of fusion, hydrogen embrittlement pmc.ncbi.nlm.nih +1
Dry Welding	Fatigue fracture (slower crack growth), ductile failure	Good; fewer porosities, slower crack propagation pmc.ncbi.nlm.nih	Minor fusion issues, possible microcracks if procedure not followed twitraining

In summary, dry welds are chosen for their superior strength, reduced crack susceptibility, and consistent quality, while wet welds are often limited by lower durability and several significant failure risks

STANDARDS & ACCEPTANCES CRITERIA

Underwater welding is governed by several international standards, the most widely referenced being AWS D3.6M:2017 (Underwater Welding Code). This code prescribes stringent acceptance criteria and defines three quality classes for welds, each with different serviceability and inspection requirements.



Thanks!

Open Discussion

- Commercial Diving – Surface Supply Diving
- Scuba Diving – Open Circuit / Semi-closed circuit / Closed circuit (Rebreather)
- Public Safety Diving
- Navy or Military Diving
- Technical Diving



Commercial Diving and Underwater Welding / Cutting

info@neeldiving.com

9249987888

www.neeldiving.com

