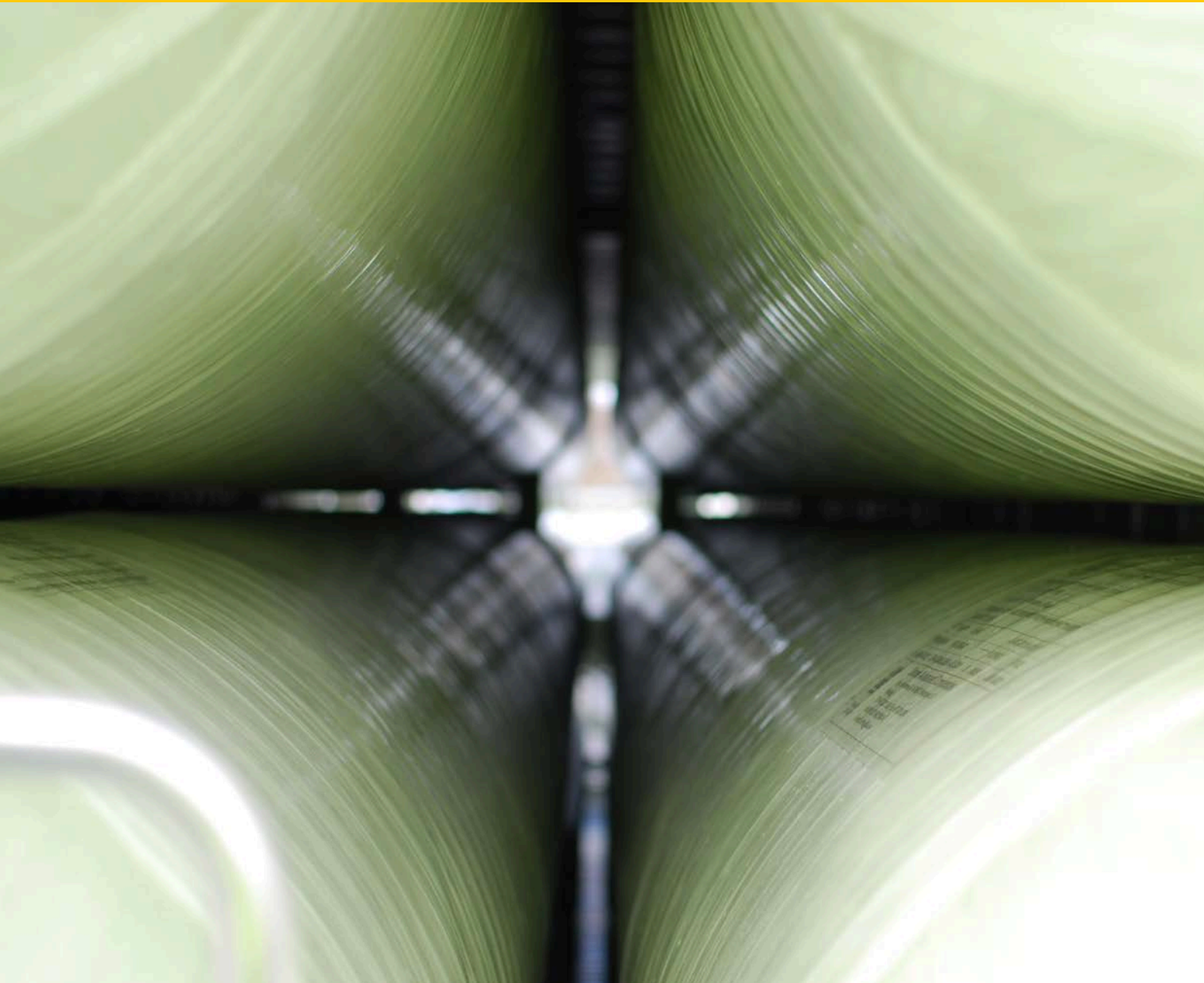




ADVANCED
COMPOSITES



CNG, biogas and hydrogen storage and transportation solutions.

ESTABLISHING NEW STANDARDS FOR COST AND PERFORMANCE



The future is LIGHTER.

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UMOE Advanced Composites (UAC) is the leading global supplier of large fibre glass type IV pressure vessels and modules for containment, storage and transportation of CNG, biogas and hydrogen for land-based, marine and offshore applications.

WE ARE UAC



Our mission is to improve our customers' profitability and eco-friendliness through use of composite solutions, replacing traditional materials.

Since our foundation in 2006, our strategic focus has been on development and specialized production of large fibre glass type IV pressure vessels for containment, storage and transportation of compressed CNG, biogas and hydrogen as well, as accumulator systems for motion compensation of offshore drilling rigs, winches and subsea cranes.

Our team of industry experts consists of highly skilled engineers and production specialists that hold three decades of experience in composite technology development and manufacturing, as well as, professionals with multi-skilled expertise from industrial energy, shipping, oil & gas, business development and innovation sectors.

We are committed to utilizing our specialized expertise and R&D efforts in close partnership with national and international research centers and certification societies, in order to offer our customers' safe, sustainable and most cost-efficient solutions that minimize emissions and contribute to a cleaner environment.

UMOE GROUP

UAC is a subsidiary of Umoe Mandal AS, and is part of Umoe Group – one of Norway's largest privately-owned investment companies specializing in biofuels, advanced materials, forestry, marine, offshore, renewables and naval industries, and service sectors. Umoe Group employs close to 6 000 professionals in Scandinavia, Canada and Brazil.

Building sustainable value.



Our heritage

Our extensive experience in development and manufacturing of advanced products in fibre glass materials dates back to 1988.

As part of a dedicated R&D department at Umoe Mandal, a purpose-built shipyard, specializing in Fiber Reinforced Polymers, our team has led the design of revolutionary naval and commercial vessels, and advanced components in composite materials to some of the most demanding industries worldwide.

We continue to build on our expertise in implementation of composite materials, steadily advancing into new segments and application areas in land-based and marine industries.



30 years of combined composite expertise.



R&D

We continue to explore new alternatives to the industry's demand for more efficient solutions for storage and transportation of gases, as well as, pursue specialized, project-specific requirements.

We have formed strong partnerships with leading academic institutions, certification societies and industry experts that carry both extensive technology, manufacturing process and composite materials knowledge, as well as operational experience.

Currently, we are exploring use of hydrogen onboard ships. Our design will allow for expanded hydrogen storage capacity and use of hydrogen as fuel source, as part of an integrated propulsion system.

We participate in Norwegian state-funded R&D programs, developing smarter solutions to meet our customers' operational requirements and evermore-demanding industry standards, and to realize our responsibility to the environment.

Facing the future with innovation readiness and capability.



Design, production and testing

We are equipped and experienced to perform full-scale testing of high-pressure vessels in a controlled environment.

Quality assurance and pressure testing is essential in developing and manufacturing pressurized equipment. Our purpose-built design and production facilities include a secure test cell to accommodate most stringent assessment of critical properties of UAC pressure vessels with minimum safety level of 3.0 in fire, automated fatigue, stress rupture, burst (of up to 1 600 bar), impact and proof tests.

Years of experience in demanding industries, such as offshore Oil & Gas, where the requirements for precision, safety and documentation are stringent, have strengthened our expertise and commitment to continuously advance performance and safety of our products.

**Increasing efficiency through optimum materials,
LEAN design- and production methods.**

SOLUTIONS AND APPLICATION AREAS



Composite materials are increasingly becoming the preferred choice in a number of land-based, marine and offshore businesses, while use of natural gas, biogas and hydrogen is taking a firm stand as the cleaner fuel source.

UAC pressure vessels and transportation solutions are purpose-designed to meet industry standards and customer requirements for sustainable and more cost-efficient alternatives.

UAC pressure vessels are designed for efficient storage of high-pressure CNG, biogas and hydrogen at production and consumption sites, as well as for safe transportation on land, at sea and offshore.

**Ensuring high-performance utilization,
extending service lifetime to 25+ years.**



Type IV pressure vessels

UAC type IV pressure vessels in high-strength fibre glass and epoxy resin materials are delivered with plastic liner, stainless steel leak-proof endbosses and customized manifold configurations.

Composite materials have lightweight, very robust, non-toxic and non-corrosive properties, eliminating risk of galvanic oxidization. UAC pressure vessels have wide temperature tolerances (-40°C/+65°C), excellent fatigue properties, durable lifetime and high safety levels, compared to steel and carbon-fibre solutions. Fibre glass pressure vessels are a price competitive alternative to carbon fibre cylinders.

UAC pressure vessels for gas storage and transportation are type-approved according to EN 12245-3, ADR/TPED/PED.

Standard type IV pressure vessels

Working pressure (bar)	Water volume (liter)	Length (mm)	Diameter (mm)	CNG / Biogas capacity (kg)	Hydrogen capacity (kg)
200	1 650	5 720	708	296	24
250	1 650	5 720	728	350	31
300	1 650	5 720	739	396	35
350	1 650	5 720	750	422	40
200	1 700	5 860	708	305	25
250	1 700	5 860	728	361	31
300	1 700	5 860	739	406	37
350	1 700	5 860	750	434	41
200	1 925	6 600	708	346	28
250	1 925	6 600	728	408	36
300	1 925	6 600	739	460	41
350	1 925	6 600	750	492	46



Road

Our solutions for transportation of CNG, biogas and hydrogen consist of UAC type IV fiberglass pressure vessels, fixed in all-metal ISO standard or High Cube modules, or in MEGC hook-load containers.

The combination of low weight, high-strength fibre glass pressure vessels and lightweight design of our fully metal transportation modules offer optimized space utilization for transportation of larger gas volumes, while ensuring highest safety measures in case of collision or overturned vehicle.

UAC MEGC hook-load containers are designed to offer a more flexible and operationally viable solution. These modules are delivered with a steel hook frame and aluminum container walls, for easy loading/offloading by the equipment on the truck or onto a trailer.

We supply standard configurations and tailored solutions to meet specific customer and regulatory requirements, and offer design and structural analysis for integration of UAC pressure vessels onto clients' own transportation units.

Design tailored for safe and cost-efficient logistics.



We are breaking new ground by offering safe and price-competitive solutions for optimal containment, storage and transportation of larger volumes of compressed gases, challenging traditional steel and carbon fibre alternatives.

Transportation modules

Container size: Up to 45 ft.

Container capacity: Up to 42 350 L water volume

Container types:

- Hook load (SS3021 or SFS4417): Galvanized steel frame with aluminum box
- ISO Standard or High Cube

Manifold connections:

- Hook load: NGV 1&2, hose NGV 1&2, Din 477-1
- ISO: Customized configurations

Hydrogen applications:

- Fully welded piping system
- Customized filling connection

Approvals:

- EN 12245-3, ADR / TPED
- Containers can be delivered in compliance with CSC requirements.



Transportation modules for CNG and Biogas

Container size	Unit	20' Hook MEGC	20' Hook MEGC standard	20' ISO standard	20' ISO high cube	40' ISO standard	40' ISO high cube	45' ISO standard	45' ISO high cube	Remarks
Number of cylinders	#	8	9	9	11	18	22	18	22	
Cylinder volume	l	1 650	1 650	1 650	1 650	1 700	1 700	1 925	1 925	
Total storage volume (Wc)	l	13 200	14 850	14 850	18 150	30 600	37 400	34 650	42 350	
Storage capacity (Wp 200 bar)	kg	2 371	2 667	2 667	3 260	5 497	6 718	6 224	7 607	@15C
Storage capacity (Wp 250 bar)	kg	2 799	3 149	3 149	3 849	6 489	7 931	7 348	8 981	@15C

Transportation modules for Hydrogen

Container size	Unit	20' Hook MEGC standard	20' ISO standard	20' ISO high cube	40' ISO standard	40' ISO high cube	45' ISO standard	45' ISO high cube	Remarks
Number of cylinders	#	9	9	11	18	22	18	22	
Cylinder volume	l	1 650	1 650	1 650	1 700	1 700	1 925	1 925	
Total storage volume (Wc)	l	14 850	14 850	18 150	30 600	37 400	34 650	42 350	
Storage capacity (Wp 200 bar)	kg	222	222	271	457	558	517	632	@15C
Storage capacity (Wp 250 bar)	kg	269	269	329	555	678	628	768	@15C
Storage capacity (Wp 300 bar)	kg	314	314	383	647	791	732	895	@15C
Storage capacity (Wp 350 bar)	kg	356	356	435	734	897	831	1 016	@15C

Optimizing the balance between product performance, CAPEX and OPEX.



Railway

Replacing diesel with mainly methane gas or hydrogen as fuel for trains is gaining much attention in efforts to reduce emissions and achieve cost savings within railway transportation.

Our solutions for CNG and hydrogen fuel cell driven train applications offer optimal space utilization of fueling tenders, combining lightweight fibre glass material and robust structural design of UAC pressure vessels. Our systems are designed for fast filling operations of one hour.

Use of 20 per cent diesel and 80 per cent natural gas for dual fueling can be achieved by converting an existing engine to accommodate dual fueling; this is a marginal investment that would yield cost-saving rewards, while reducing CO₂ emissions.

UAC solutions for railway applications are approved in accordance with ADR/RID.

Cost-efficient and greener way ahead.



Offshore

UAC lightweight, high-strength, non-corrosive pressure vessels deliver optimized performance, increased safety, reduced lifecycle costs and long service life in harsh offshore environments.

We have delivered more than 3 000 pressure vessels for heave compensation accumulator systems to the global drilling fleet of high-spec semi-submersible drilling rigs and drill ships, as well as to large offshore cranes and winches for ultra-deepwater lifting operations.

UAC pressure vessels for drill strings and riser systems, cranes and winches are fitted with manometer, pressure transmitters, block & bleed valve, dip tube, drain valve and 2" - 3" isolation valves with actuator, if required.

UAC solutions for offshore applications are class-approved by DNV-GL, ABS, BV and Lloyds Register.

Heave compensation accumulators

	Working pressure (bar)	Water volume (liter)	Temperature (Celsius)	Medium
Offshore cranes	333	500 – 2 250	-40° / +55°	Nitrogen / Air
Drill ships & risers	207	500 – 2 250	-40° / +70°	Nitrogen / Air



CNG for offshore applications

We offer a compact and user-friendly solution for storage and transport of CNG from offshore infrastructures, which combines proven ISO container platform with an integrated UAC pressure vessels configuration and a safe filling system.

While increasing transport efficiency of CNG, our solution offers an opportunity to monetize on gas production and handling of flare gas offshore.

Increasing performance, reducing maintenance costs in harsh environments.



Marine

UAC solutions are designed to meet demanding industry standards and to reduce environmental footprint across the maritime supply chain.

We offer solutions for containment, storage and transportation of CNG, hydrogen and CO₂ at sea and inland waterways. UAC pressure vessels can also be integrated as part of a propulsion system, using hydrogen or CNG as fuel in combination with electric batteries onboard ferries and inshore vessels. We can handle Boil-Off Gas onboard LNG fueled ships with customized configurations of our pressure vessels.

Through assessment of the ideal pressure and temperature, we can customize our solutions for larger gas volumes, with bigger containment modules, both in diameter and length. We can supply independent pressure tanks, fixed by a cradle to the tank top, or as a compact integrated containerized system.

UAC fibre glass pressure vessels optimize containment, storage and transportation of gases in corrosive marine environments. Non-corrosive, lightweight, temperature tolerant and robust properties of our composite pressure vessels contribute to long-term design life and safety of our solutions.

UAC solutions for marine applications are class-approved by DNV-GL, ABS and Lloyds Register.

Intelligent solutions for cleaner fuels.



Gas flaring

Many industries have turned their interest to safe and efficient methods for reduction of potentially dangerous or redundant gases, generated through daily operations.

Capturing flare gas can involve handling gas, which is very corrosive, either due to the H_2S content and/or the combination of CO_2 and water. Offshore flare gas transportation occurs in corrosive environments causing reduced lifetime of traditional steel transport modules.

UAC pressure vessels and transportation modules are particularly well suited for containment and transportation of flare gas, due to the non-corrosive properties of the fibre glass, plastic-lined pressure tanks, and the robust structural design of the modules fitted with stainless steel (316 L) endbosses and stainless steel piping.

Saving energy, while reducing emissions.



UAC ADVANTAGE

UAC fibre glass type IV pressure vessels and modules for containment, storage and transportation of compressed high-pressure gases offer numerous advantages, including weight reduction, space optimization, larger volumes, superior safety levels, high-strength durability, expanded service lifetime and cost-efficiency of the overall gas logistics.

UAC heave compensation accumulator systems for drilling units, offshore cranes and winches have proven to be a reliable choice for optimal performance in harsh offshore environments.



Low cost type IV



Composite material



Ultimate safety



Design life



Technology



Innovation



Low cost type IV pressure vessels in lightweight, robust fibre glass composite significantly reduce lifecycle cost, while preserving quality, safety and the lifetime of our products. Non-corrosive properties of the material requires less frequent need for inspection, lower maintenance costs, and offer a price-competitive alternative to carbon fibre solutions.

Composite materials utilized in design of UAC pressure vessels offer non-corrosive properties, wide temperature tolerances, high-strength fatigue durability, enhanced safety and a long design life in harsh and hazardous environments, and offer up to 70 per cent weight reduction, compared to steel cylinders. Composite materials are highly flexible and scalable to accommodate larger containment and transportation gas volumes.

Ultimate safety delivered by UAC solutions is granted both by the material properties of fibre glass pressure vessels and by the structural design of our transportation modules. We subject our products to stringent fire, fatigue, stress rupture, burst, impact and proof tests. Designed according to “leak before burst” principle, our pressure vessels demonstrate superior safety levels, challenging carbon fibre and steel alternatives, and safely handle all types of high-pressure gas combinations, exceeding industry safety standards.

25+ years design life certification of UAC pressure vessels guarantees high-performance utilization and a profitable lifetime of our solutions, contributing to cost-effectiveness of our customers’ projects. Investment in high-pressure gas storage and transportation solutions can be high, and long and durable lifetime of solutions is often a customer requirement. We combine our expertise, intelligent materials and smart design to improve performance and increase profitability throughout gas supply chain.

Technology that underpins our flexible solutions for project-specific conditions and standard configurations that meet regulatory requirements is at the core of our expertise. Fail-proof materials, stringent design, production and testing processes, understanding of operational requirements of particular industries and our dedication to global efforts of reducing emissions, drives us to explore and implement solutions for a cleaner environment on land and at sea.

Innovation readiness and capability, evolution of our expertise, complementary background and experience of our team, close cooperation with class societies and participation in industry R&D projects represent a unique potential for our further advances in CNG, biogas and hydrogen applications in land and marine storage and transportation industries.

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