Oil & chemical tankers
Engineering excellence, protecting the environment
Peter von Allwörden
Ship Type Expert
Tankers
Phone: +49 40 36149-7447
peter.von-allwoerden@gl-group.com

“There are no quick fix solutions for oil and chemical tankers – they carry high risk cargo and their design requires a combination of skilled engineering and a lot of experience. At GL we offer both. The BEST-plus Aframax tanker design is proof of our dedication to innovation and finding solutions that are safe, reliable and energy efficient.”
High standards of safety and reliability

Transporting oil and chemicals by ship requires solutions that ensure the necessary levels of safety and reliability. Due to the high risk nature of the cargo, environmental protection and incident-free operations are of paramount importance. Applying the in-depth knowledge gained from long-standing experience, Germanischer Lloyd (GL) focuses on every detail of your oil and chemical tankers from pre-design to operations in order to guarantee safe and efficient transport, and maximise profitability. Our expertise has been setting standards around the world for over 140 years, making us the ideal partner for the challenges facing shipowners and shipyards in the oil and chemical tanker sector. We work hard to ensure zero threat to human life, zero damage to machinery and equipment, zero spills and zero environmental risks.

An international network

Founded in 1867 as a maritime classification society, GL has expanded to provide a wide range of classification, certification, consulting, software and training services. Today, GL can point to a network of approximately 6,900 experts across 80 countries and in more than 200 locations.

The GL Group includes FutureShip which offers specialised consulting and advanced engineering services in the fields of maritime strategy, ship design, operations and compliance, with a particular focus on fuel efficiency. GL Noble Denton, a world-class technical service provider for the oil and gas industry, is also part of the GL family. GL experts include:

- dedicated ship type experts for tankers
- specialised tanker experts for newbuilding projects
- specialised tanker experts for fleet-in-service matters
- specialised tanker surveyors around the world

Specialist know-how, extensive experience

GL was one of the first classification societies to be entrusted with double hull chemical tankers and to tackle the challenge of calculating the collision strength of tankers. GL’s COLL Class Notation is a direct result of this. We have developed solutions for corrosion protection, tank coatings / linings and fatigue problems, and we lead the way in the development of ice-going tankers. Our long-standing experience makes us the perfect partner to meet the needs of yards, owners and operators in the tanker market.

World-leading expertise in ice-going vessels

GL is world leader in the development of ice-going tankers and has classified more ice-strengthened vessels than any other classification society. GL chaired the IMO drafting group that finalised the Guidelines for Ships Operating in Arctic Ice-Covered Waters and is chairing the IACS working group to develop the Unified Requirements for Polar Ships (AHG/PSR) covering both structural and machinery components. We are participating as a classification society in the European Union research project SAFEICE aimed at decreasing the risks involved in navigating ice-covered waters.

GL innovation: BEST-plus Aframax tanker design

In collaboration with the National Technical University of Athens, and as a response to feedback from oil tanker operators, GL developed the BEST-plus Aframax tanker design concept. BEST-plus enhances the attractiveness of the initial design concept by integrating hydrodynamic optimisation of the hull form and thus reducing fuel consumption and emissions.

GL’s design approach used an advanced optimisation environment, which integrates tools to predict required propulsion power, stability, oil outflow index, cargo capacity and hull structural scantlings according to IACS CSR.

The use of advanced design technologies in Aframax crude oil tanker design resulted in considerable improvements:

- design optimisation reduces cost of transport
- an optimised hull increases speed and improves cargo capacity
- double hull improvements lead to enhanced safety and reduced environmental impacts

Moreover, the BEST-plus design concept enables tankers to outperform the Energy Efficiency Design Index (EEDI). This is a measure of a vessel’s inherent fuel efficiency and compares CO₂ emissions to transport work. A reference EEDI is determined by the IMO for each type of ship, e.g. for tankers. Ships built using the BEST-plus design concept, which exceed EEDI benchmarks, have the ability to remain competitive for longer than non-optimised designs.
Germanischer Lloyd offers much more than mere classification of tankers. GL’s broad spectrum of high quality services is tailored to the requirements of every phase of a tanker’s lifecycle and helps improve a vessel’s energy efficiency and competitiveness in a tough market. GL’s comprehensive portfolio of oil and chemical tanker services includes:

**Hull design**
- intelligent and efficient hull design (POSEIDON)
- prediction of global design loads
- prediction of slamming and sloshing loads using CFD methods
- shipboard routing assistance
- CFD analysis of loads and cavitation of rudders, propellers and propulsors

**Strength & fatigue**
- global structural strength analysis
- local structural analysis
- fatigue analysis of critical details
- strength analysis according to Common Structural Rules (CRS)
- collision analysis

**Vibration & noise**
- global vibration prediction
- local tank and deck panel vibration analysis
- mast vibration analysis
- shaft vibration analysis
- GL noise review
- noise predictions
**Pre-design expertise**

At the pre-design stage, important parameters can be verified by feasibility studies, classification pre-checks, and in the case of chemical tankers, a Certificate of Fitness. Cost efficiency can be optimised at this early stage by implementing appropriate design modifications before they cause costly changes.

**Meeting the challenge of hazardous substances**

For chemical tankers it is particularly important to determine as early as possible which chemicals should be included in the Certificate of Fitness. GL has developed a database containing the resistance lists of major coating manufacturers. This enables the chemicals listed to be aligned with specific coatings so that a tanker can be designed and constructed to meet these demands. Establishing such a list is generally part of the specifications review (see below). GL also offers a special service to enable the addition of further chemicals into a tankers certificate at later stages.

Technical services offered by GL at the pre-design and design stages include:

- specification reviews
- pre-plan approvals
- consultancy services for owners
- modifications
- conversions

**Design expertise**

**Tank protection ensures long-lasting ships**

Ships, systems and components should be designed with the aim of ensuring optimum corrosion protection through the application of suitable structural measures. Furthermore, tank coatings are a key issue on chemical and oil tankers. Choosing the right material or coating is of decisive importance in avoiding damage to a tank or cargo. Therefore, the coatings selected must be suitable for the respective application in accordance with the manufacturer’s specifications.

During the design phase GL provides tank design support. At later stages, specially trained GL surveyors attend and monitor the surface preparation and coating application. Lifetime maintenance is evaluated in a similar manner during regular class surveys.

**Sloshing analysis for optimised structural design**

Global motions can trigger violent sloshing in tanks. This causes large loads on tank structures. In a sloshing analysis the flow and motions of a ship advancing in selected design waves are systematically computed according to relative velocities for different ship speeds, wave heights and lengths. The resulting data provides information on pressure distribution and offers benefits for:

- improved structural design based on accurate hydrodynamic load prediction
- optimised scantlings
- measures to avoid impact loads
- time-efficient predictions
- resonance investigations

**Collision analysis: identifying risk control measures**

Concern about loss of human life, damage to property and the environmental pollution caused by ship collisions is high. Therefore, assessing the collision resistance of ship structures and optimising the side construction of ships to safeguard against collisions is vital. The GL class notation COLL offers assessment and classification of collision resistance capabilities for existing side constructions of ships. Substantial improvement of collision resistance is also advantageous to other ship design aspects, for example the fulfilment of damage stability criteria according to SOLAS, or the increase of permissible tank volume for inland waterway tankers.
Construction and fleet-in-service expertise

Corrosion protection: assuring long-term value

GL developed its Rules for Corrosion Protection of Crude Oil Cargo Tanks (Cargo Tank Coating) to meet shipowner and operator concerns about operational reliability and corrosion resistance.

The internal structure of oil tankers’ cargo tanks are exposed to the corrosive effect of sulphur, seawater, crude oil and all possible mixtures thereof. Different types of corrosion problems occur in oil cargo tanks during tanker operations and a good corrosion protection system offers a ship operator various benefits:

- conservation or long-term maintenance of a ship’s value
- advantages in receiving charter contracts
- reduction of maintenance and subsequent costs

The GL Rules ensure the application of good corrosion protection measures. They cover:

- surface preparation
- design considerations
- coating performance standard – this defines requirements concerning areas to be protected, surface preparation, selection of coating materials as well as application of coating systems
- competent repair of damage and defects in coating systems during construction period
- testing, acceptance and documentation of surface preparation and coating system

GL offers extensive support through certification of coating work that is in line with the GL Guidelines for Corrosion Protection and Coating Systems.
Condition Monitoring: increased reliability of systems and components

GL offers one-stop shop solutions for Condition Monitoring (CM) systems and provides advice on the best possible solution for your oil and chemical tankers. We provide:

- minimisation of investment risk through a tailor-made condition-based maintenance (CBM) concept
- non-biased support in selecting the optimum CM system(s)
- assistance in compiling the documents required for the GL Survey Arrangement CM

Reducing hazards, enhancing design: risk and reliability assessments

In a risk assessment, a system or process is analysed with respect to the likelihood and consequences of incidents and accidents. GL’s risk and reliability assessment takes a proactive, preventive approach to analyse potential threats to human life, property and the environment in a structured and comprehensive manner. The advantages of risk assessment include an increased certainty regarding system-inherent hazards, combined with enhanced design flexibility.

During the operational life of your tanker, the identified risks are managed through a safety management system, as required by the ISM Code. The TMSA (Tanker Management and Self Assessment) programme provides operators with a means to assess risks, identify hazards, manage change and investigate and analyse incidents.

Condition Assessment Programme: demonstrating quality

The Condition Assessment Program (CAP) is a consultancy service offered by GL. It provides owners and charterers with an independent, in-depth assessment and verification of a ship’s condition. In addition to classification, CAP is an ideal means of demonstrating the quality of the vessel and is becoming increasingly important in preventing unexpected downtime. Major oil companies such as BP, Statoil, Petronas and Norsk Hydro recognise the GL CAP certificate.

CAP is mainly intended for tankers older than 15 years - a CAP certificate enables older tonnage to be accepted by many charterer and operator vetting programmes. Some port states, such as India, will only allow foreign flag vessels with a CAP rating of 2 or better to enter their ports. CAP provides you with:

- independent assessment of a vessel’s technical condition – it monitors all sections and spaces of a ship for damage, deficiencies, maintenance, wear and tear
- comprehensive documentary evidence of hull, machinery, electrical installations and cargo-related systems
- help in improving safety standards and reliability

Strength and fatigue analyses: identifying design solutions

The aim of strength and fatigue analyses is to determine critical parts of the cargo area structure to which particular attention needs to be paid.

The strength analysis evaluates the original dimensions and the actual scantlings on the basis of a thickness measurement report on the structural elements and in terms of the envisaged CAP rating.

The fatigue analysis evaluates the welded joints of the structural elements on the basis of the applicable number of load cycles. The welded connection type is defined by means of an associated detail category. The higher the detail category, the more critical the welded connection of the structural elements is in terms of remaining fatigue life expectancy.

The benefits of strength and fatigue analyses include:

- early identification of potential problem areas
- reduction in weight after carrying out optimisation
- support in development of new and unique designs
- identification of critical design solutions
- support in evaluating production-optimised solutions
- balanced utilisation of structural components
- increase in reliability and safety of ships
- reduced repair costs within the service time
Monitoring a vessel’s hull with the Hull Lifecycle Programme

The Hull Lifecycle Programme (HLP) is GL’s class notation to monitor the technical condition of a tanker throughout its lifetime. It focuses on monitoring and assessing hull condition by means of thickness measurements. HLP comprises an IT-driven approach and computer tools based on a 3D computer model of the vessel. It provides full support for systematic data collection, visualisation and assessment of the hull’s structural condition and integrity.

Improving schedule integrity with Shipboard Routing Assistance

The Shipboard Routing Assistance (SRA) is a system developed by GL to provide a ship’s officers with the necessary support and data to avoid weather conditions and seaways that may cause damage to ship and cargo.

It combines advanced computations with seaway measurements, and informs the officers not only of the severity of current conditions but also of what lies ahead. It gathers information from weather forecasts, measures wave conditions, the vessel’s loading condition, speed, course, heading and route to allow continuous monitoring of ship responses, possible hazards and their consequences. The benefits for owners and operators are manifold:

- enhanced schedule integrity and avoidance of costly delays
- navigational assistance to maximise schedule integrity
- greater safety through effective measures to counter hazards
- possibility of lower insurance rates due to reduced risk of damage to ship and cargo
- quantifiable service performance

Boosting fuel efficiency

GL FutureShip has developed a broad range of tools and services to enhance the performance of your vessels by boosting fuel efficiency:

- ECO-Chances evaluates and optimises a ship’s fuel and emissions performance.
- ECO-Solutions is based on focus areas identified by ECO-Chances and offers detailed fuel efficiency analyses to help a ship reach its energy efficiency potential.
- ECO-Assistant is an easy-to-use, stand-alone software application to ensure that your vessels sail at optimum trim all the time.
GL environmental services: green, clean and safe shipping

GL has always been committed to green shipping. Safety and environmental protection are our highest priorities. We offer environmental services that are designed to protect the marine environment and enhance the sustainability of maritime activities, while boosting the efficiency and profitability of oil and chemical tankers.

GL’s Environmental Passport (EP) documents a ship’s environmental performance through a system of voluntary and mandatory certification. It focuses on:

- engine and incinerator emissions
- vapour emission control systems
- refrigeration systems
- firefighting pollution from oil and noxious liquid substances
- pollution from sewage or garbage
- ballast water management
- anti-fouling systems

Irrespective of class, the Environmental Passport is open to all parties in the maritime industry. It enables our clients to minimise their environmental footprint and demonstrate environmental excellence.

Where experts learn more: the GL Academy

GL has gained a great deal of technical expertise and practical know-how in the maritime sector. At the GL Academy we channel this knowledge into training seminars in the field of shipping and management systems. The Academy programme covers topics of relevance to the shipping community, and is constantly being adapted to suit the needs of shipowners, operators and crews.

We offer customised seminars on technical and operational aspects relating to oil and chemical tankers covering such topics as:

- tanker types, design and construction
- relevant organisations and regulations concerning tankers (e.g. IMO, IACS, OCIMF, SOLAS, MARPOL, IBC Codes)
- plan approval, newbuilding supervision, surveys and certificates
- technical and operational aspects (e.g. cargo operation, tank cleaning, ballast operations, environmental aspects)
- safety aspects (e.g. gas-freeing of cargo tanks, tank inspection, fire protection and firefighting)

Seminars are held at GL Academy premises, your premises or any other location of your choice.
Oil and chemical tanker expertise for shipyards

Pre-design expertise
Ensuring compliancy
Stricter regulations on safety have resulted in the development of double hull tankers, whilst regulations on CO₂, sulphur oxide and noise emissions are set to become more restrictive in the next few years. ILO MLC and Inventory of Hazardous Materials (IHM) certification is also compulsory. All this has led to an increasingly restrictive regulatory environment for oil and chemical tankers. For shipyards, it is of prime importance to keep up to date on all the latest requirements.

GL is ideally placed to provide guidance on all matters of compliancy. We act as advisors to governments, flag states and port states, and can ensure that their requirements are addressed at a very early design stage to avoid costly changes and refits at a later stage. Our expertise allows us to interpret regulations and to know what developments are expected in the future. Our one-stop shop for maritime certification saves time, effort and money by offering combined certifications or audits.

Design expertise
POSEIDON: an easy-to-use design tool
GL’s POSEIDON engineering provides a preliminary design tool that can be used throughout the engineering process.

Since April 2006, the IACS Common Structural Rules (CRS) have been in force for all tankers, single or double-sided, of at least 90 metres in length and for all double hull tankers of at least 150 metres in length. GL has developed calculation packages that facilitate efficient support for ship designers and shipyards. The advantage of safer and more robust ships goes hand in hand with a higher degree of computerisation. A safe design, and in particular verification of this, is impracticable without well-developed and proven software.

POSEIDON is a state-of-the-art tool suitable for all aspects of the design of tankers. It is easy to use and allows for rapid changes in structural layout which help optimise the design at the earliest most cost-effective stage, thus saving steel and creating a more efficient ship. Tank structures can be easily defined and sloshing calculations carried out. POSEIDON includes:

- modelling of complete symmetrical or asymmetrical hull structures
- hatch cover assessment

The tool requires only basic knowledge of FE theory and a minimum of training.

Mastering key technical challenges
Currently, the key technical challenges for shipyards are operational safety, Ice Class size, conversion work and fuel efficiency. Successfully tackling these challenges involves a rapid time-to-market from development through design to construction.

FutureShip’s many years of know-how in fuel and operating efficiency ensure excellent advice on energy-optimised ship design in the oil and chemical tanker sector. We deliver designs that:

- maximise cargo volume
- minimise weight
- lower operating expenses

This enables shipyards to provide energy efficient solutions that ensure profitability in a highly competitive market.

The “Bit Viking” – converting from oil to dual fuel
As GL experts continue their scientific research into LNG as a ship fuel, the first successful GL-supported conversions and designs are opening a new chapter in shipping: The “Bit Viking” is the result of GL’s participation in the conversion of an existing oil-burning engine into a dual-fuel one that can burn either fuel oil or gas. The project has put the GL Group centre stage in the development of LNG-fuelled vessels. GL was chosen for the classification part of the conversion, due to our broad experience in LNG.

The manufacturing of various new components began in early 2011. The components were then transported to the shipyard where the new equipment, necessary for LNG operation, was installed in the vessel. GL experts played a critical role in this process, monitoring the manufacture and installation of the components, such as piping, valves, safety equipment and LNG tanks, and ensuring safe construction, use of suitable materials and application of appropriate welding methods.
Safe, reliable, efficient: tankers with GL Ice Class notations

Nowadays, the global fleet of ice-strengthened tankers is growing at a phenomenal speed. GL classes more ice-strengthened ships than any other classification society. Nearly 1,000 GL ships comply with the Finnish/Swedish Ice Class Rules and around 280 of them are tankers.

GL offers extensive experience in classification of ice-strengthened vessels:

- assistance in conceptual design
- optimisation of ice-strengthened structural and machinery designs
- selection of material grades for low temperature service
- direct calculation of propeller thrust (with respect to engine output requirements)
- calculation of safe operating speeds
- total risk assessment of operations in ice
- optimisation of bow shape design and direct calculation of vessel resistance in ice (in co-operation with Hamburg Ship Model Basin)

GL: world-class oil and chemical tanker notations

Our experience is reflected in the following class notations:

- Oil Tanker
- Chemical Tanker – Type 1,2,3

Moreover, we offer the notations:

- COLL
- CSR
- RSD
- ESP
- IW
- ERS
- VEC
- CTCOAT
- BW
- INERT
- SPM1, SPM2, SPM3
- RP1 x%, RP2 x%, RP3 x%
- DP1, DP2, DP3
- STL
- EP
- HLP

- Strengthening for collision
- Common Structural Rules
- Rational Ship Design
- Enhanced Survey Programme
- In-Water survey
- Emergency Response System
- Vapour Emission Control
- Cargo Tank Coating
- Ballast Water Management
- Inert gas system
- Single Point Mooring
- Redundant Propulsion
- Dynamic Positioning system
- Submerged Turret Loading
- Environmental Passport
- Hull Lifecycle Programme
This brochure was produced with consideration for the environment. It is printed on paper that is 100% recycled and has an FSC accreditation.

The GL Group does not warrant or assume any kind of liability for the accuracy, completeness or quality of the information provided. Liability claims against any member of the GL Group in relation to any loss or damage arising out of or in connection with the use or non-use of information provided, including the use of incorrect or incomplete information, are excluded to the fullest extent permissible by law. All presentations of services and products may be subject to alteration and are non-binding. Each GL Group member expressly reserves the right without notice to change, supplement or delete parts of the pages or the entire presentation of services and products or to stop the publication temporarily or definitively.