MARITIME

DNV GL RULES FOR SHIPS

Shaping classification for the future
As a classification society, it is our pleasure and privilege to work with customers and partners like you from across the entire maritime spectrum. Through the merger process, we realized we had a unique opportunity to offer you something truly special because of the nature of the new DNV GL organization.

We wanted to offer you something unprecedented, a set of rules and services that would set the standard for the industry - the result of an unmatched depth of experience and expertise.

Making sure that all the partners in a maritime project are able to deliver and receive the best possible asset is a truly cooperative effort. So we reached out to customers and stakeholders like you to ensure that the rules could truly be said to have been developed in cooperation with the industry.

We are very grateful for the generous input and have worked to make sure that this is reflected in the rules.

We are facing challenging times, with the future of the industry looking like it will be very different from the past. We all face a more competitive environment than ever before, with a rising tide of regulations. To respond, we wanted to offer you a rule set that incorporated the most up-to-date standards, integrated more modern tools and software and would be flexible to respond better to future developments.

The hull structure rules have a new advanced load concept that is a major step towards a more realistic representation of the environmental loads. Along with state-of-the-art capacity models, this concept will increase the consistency in structural design, making sure you get the most out of every ton of steel.

We have also invested considerable effort into making the rules easier to work with. Structurally, each individual rule book is set out to complement and follow the typical design and approval process.

The new rules should enhance your experience of working with us in the overall design process, so we have brought all vessel-related requirements together in one place. As an easy entry point to a new design, 38 Ship Type Class Notations have been defined, while any documentation and certification requirements are clearly summarized in all parts of the rules.

The result is a set of rules for your new project that are like no other. We hope that we can work with you to use them as the foundation to deliver the best possible assets for you and your customers.

Knut Ørbeck-Nilssen
CEO DNV GL - Maritime
At DNV GL, our drive to innovate in the maritime industry goes back to our origins. Throughout the history of both organizations, we have been at the forefront of moving ship classification and development of class rules forward to ensure greater safety and efficiency.

The principal dimensions
One of the co-founders and elected board members of Germanischer Lloyd (GL) was Mr Friedrich Schüler. He was an experienced shipbuilder, and soon after the foundation of GL in 1867 he was entrusted with the task of rule development. In October 1868, Mr Schüler presented the young society’s own construction rules.

At the time, the necessary sizes of the individual components were determined by often vague measurement of a ship in tonnes. Schüler took a different path by defining “scantling numerals” that related to the actual ship dimensions. For the first time in history, the principal dimensions of the ship – lengths, breadths and drafts - were the decisive parameters for the primary structural members. This approach made it possible to assess the strength of a ship by comparing the relationships of these values.

To lay the foundations for this system, Schüler statistically evaluated a large number of existing ships, thus obtaining a load-related dimensioning system which took into consideration the many years of experience of the yards. This approach was progressive for the time, and was rapidly adopted by other classification societies.

From tables to engineering science
In 1951, Professor Georg Vedeler was appointed CEO of DNV. Just a few months after he had taken office, Vedeler presented a critical picture of the rules of classification societies at the time:

“Today, we can handle the theory of structures as complicated as ships or their component parts much better than only a few years ago, and we can take a much more critical look at the rules and tables.”

With this in mind, he began the process that led to DNV renewing its rules. Founded on the most advanced scientific and technical knowledge available, he created a new basis for the rules: “The proposed new rules are based, to a greater extent than usual, on simple formulae for dimensioning the different components. These formulae have been established using the best possible theoretical reasoning, but must always contain an element of experience which brings the results in line with earlier practice.”

The concept of engineering science made it possible to adopt new and untried solutions and dimensions, and represented a substantial breakthrough in terms of classification rules and ship design.

To create a better basis and wider acceptance for the new rules, Vedeler also established a technical committee. He noted: “Unlike earlier changes to the construction rules, they have been circulated widely for comment on this occasion, not only among our own surveyors, but also to all Nordic shipbuilders and shipping companies with technical departments. The proposals have been seen by hundreds of technical experts, and valuable criticism has been made to us.”

The new DNV GL rules
DNV GL has now built further on the legacy from these two pioneers, introducing new methodologies and innovations to move the maritime industry forward and leave it better prepared for the challenges ahead.

We were the first to introduce rules based on actual dimensions and statistical research in 1868. In the 1950s we went from an empirical approach to engineering science. Today, some of the keywords are direct load calculations, modern tools and battery/hybrid propulsion. The foundation of the rules remains the same - the most advanced and scientific knowledge and experience available.

The parallels between the past and the present are many. The ambitions, the future-oriented approach, the involvement of the industry and the importance of utilizing our experience, by bringing the results in line with earlier practice - there is a common thread in the development, anchored in our traditions of safeguarding life, property and the environment.

Learn more at dnvgl.com/dnvglrules
The new rules define the complete DNV GL maritime classification service portfolio and are divided into eight rule books covering different regimes:

- Each rule book is divided in a logical and easy-to-grasp structure
- The structure follows a typical design and approval process
- Redundant content is avoided to ensure uniformity in requirements and consistency throughout the rules
- Additional class notations are grouped in 10 different main topics

**The eight rule books**

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**Rule book SHIP**

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For more information about all class notations, please visit [dnvgl.com/dnvglrules](http://dnvgl.com/dnvglrules)
Rules for classification have traditionally been developed through half-yearly revisions and amendments to existing rules. The merger gave us the opportunity to create a new common basis.

In what is probably the biggest and most extensive investment ever made by a class society, over 200 engineers at DNV GL have been dedicated to bring a modernized, efficient and state-of-the-art set of rules to the maritime industry. Not only by incorporating the latest technology developments, but also by doing a comprehensive restructuring and modernization of the complete rule set.

Our aim has been to create a clear and logical structure allowing for easier application, thus providing the basis for a lean, timely and cost-efficient classification process.

Involving the industry
Making sure that all the stakeholders in a shipbuilding project are able to deliver and receive the best possible ship is a truly cooperative effort. And the classification rules that guide the design and construction are an important part of that process.

From the beginning of the rule development project, we wanted these rules to be unique in the way they reflected industry experience and input. Our objective was to have our customers and stakeholders deeply involved throughout the rule development and implementation process.

In the first step of this cooperative journey, industry partners in Norway, Germany, Korea, China, Greece and Japan were invited to become involved in an extensive period of cooperation, commenting and evaluation. More than 180 customer events were initiated to exchange views and experience regarding the new rules - an essential part of gathering valuable input.

In a formal external hearing process, more than 800 customers worldwide were asked to comment on the rule text and requirements. In all, more than 2,000 detailed comments by yards, manufacturers, owners and other maritime stakeholders were submitted. Members of our Technical Committees from around the world also contributed with ideas and suggestions for improvements.

This level of engagement by our industry partners will benefit everyone working with us on future projects.

“The new DNV GL rules seem to be an appropriate approach for current and future optimized vessels. The new approach will bring both worlds of prescriptive rules and direct calculations closer together. This is a very important step forward.”

Broder Hinrichsen
Executive Vice President,
Flensburger Schiffbau Gesellschaft
Demonstrating the benefits

In order to show that the rules can deliver the quality, safety and process efficiency the industry expects, we have performed consequence assessments and impact studies for all ship types. By working closely with ship designers and yards, we have re-evaluated existing designs and proven that the rules are in line with our expectations. In addition, this process has enabled us to identify areas for further improvements.

Together with leading yards and designers in China, Korea, Germany and Norway, many joint projects have been initiated to facilitate the development of new and enhanced designs based on our new rules. We are looking forward to initiating more projects with our customers worldwide.

Learn more at dnvgl.com/dnvglrules

“The new rules will stand as high landmark among maritime rules, viewing that they are in line with the base spirit of goal-based standard and are a mixture of experience and technology.”

B.R Lee
Vice President,
Hyundai Heavy Industries
The creation of the rules has allowed DNV GL to incorporate and integrate more modern tools and software and has enabled us to build the rules to make them more responsive to the needs of your next newbuilding project.

In order to fully capture the potential in marine engineering and computerization offered by the latest technology, DNV GL has developed new rules for hull structures. These rules are an improved foundation for ship designers to construct vessels that are optimized to meet the needs of their customers. They also provide an enhanced framework for designing innovative solutions for the maritime industry.

**Combining accuracy with efficiency**

The introduction of Equivalent Design Waves (EDW) marks a significant change in the way dynamic loads are calculated in the DNV GL rules. The new advanced load concept is a major step towards a more realistic representation of the environmental loads.

Along with our state-of-the-art capacity models, this concept will increase the consistency in the safety level applied for the complete hull structure. In addition, this approach will also accommodate challenges related to the development of novel and unusual designs.

The EDW approach will provide for a more accurate representation of the dynamic loads and consequently enable a more precise stress distribution for the ship structure. Combined with the latest structural capacity models and clearly defined acceptance criteria, it will give designers and shipyards an improved framework to address critical areas. As such, it will also provide for a better basis to optimize the structure. To verify that the new methodology is in line with operational experience, we have performed extensive consequence assessments of existing designs.

**The state of the art - simplified**

Presently, the most advanced and accurate load response analysis that can be performed is full spectral analysis (FSA). This method investigates the responses on a structure exposed to a full range of multidirectional waves for specified sea spectra. But the time-consuming and costly nature of this method makes it unsuitable as a general approach for ship design.

An equivalent design wave (EDW) is a wave for which a selected structural response is equal to a target value for an extreme response from the FSA. An EDW aims to recreate a similar dynamic response for a specific target area.

The EDW approach significantly reduces the number of required structural response calculations needed to obtain a good representation of the environmental loads. And we have made a substantial effort in research and comparison studies to ensure that the EDW approach provides similar results to those of the FSA.

Compared with a full spectral analysis, the major benefit of the EDW approach is that it significantly reduces the computational time and costs while providing the same realistic results. It also allows us to derive simplified formulas for hydrodynamic loading and associated load combination factors.
In short, the new rules will accommodate designers to apply the steel where it is really needed. This will result in ships more suited for their purpose, requiring less maintenance and repair during their lifespan.

To account for the more advanced load descriptions, our calculation tools have been significantly updated, providing even better support for an efficient design process.

In addition, an extensive effort was made to ensure that the calculation scope is in line with the respective ship type. Flexibility is provided by allowing both simplified conservative requirements and advanced direct analysis. Combined, the new rules and tools will give a much improved basis for developing designs that are fit for their purpose.

The application of EDW in the new DNV GL rules represents an important shift towards a more consistent and accurate load description. Through a substantial effort in research and comparison studies, DNV GL has made the approach suitable for the complete range of ship types, shapes and sizes.

Learn more at dnvgl.com/dnvglrules
To enable owners to efficiently customize vessels for their needs, the rules offer a variety of class notations. These are tailored towards ship types and additional features, and ensure that vessels are designed and equipped for the intended operations. In addition, they are made and continuously developed to support application of the latest technology developments.

The future is hybrid
Electric and hybrid vessels with energy storage in batteries and optimized power control can provide significant reductions in fuel consumption, maintenance and emissions. Such solutions also enable improved ship responsiveness and thereby improved operational regularity and performance, as well as safety in critical situations.

One of the technical highlights of the new DNV GL rules is the class rules for battery-driven vessels and large lithium battery systems. Complementing the existing rules for batteries introduced in 2012, the new rules will include a revised and improved version which also covers the use of batteries as a power source for dynamic positioning (DP) systems.

The additional class notation Battery (Power) applies to battery installations in battery-powered vessels, vessels with redundant propulsion, or DP vessels where the batteries are included in the redundancy for dynamic positioning.

The additional class notation Battery (Safety) applies to battery-hybrid vessels. This notation is mandatory for vessels where the battery installation is used as an additional source of power and has an aggregate rated capacity exceeding 50kWh.

Read more about batteries for use in shipping in DNV GL’s publications “The Future is Hybrid” and the guideline for large battery systems.

Both are available on: www.dnvgl.com/battery-hybrid

The next step to greener operations
DNV GL is already playing a key role in the development of new technologies, services, standards and recommended practices for the LNG sector. We work in partnership with a number of LNG pioneers, and our expertise in this area has led to many LNG firsts – including most recently Gas ready and Gas bunker vessels. These are all now integrated into the new rules – as well as the newly passed IGF Code requirements.

Other examples
- Ballast water treatment - BWM
- Fuel-cell installation - FC
- Shore power
- Environmental class - Clean
- Gas-fuelled
- Emission controlled area - ECA

Gas ready
DNV GL’s new Gas ready notation gives owners who want to prepare their vessel in the new building stage for a potential conversion to LNG operation after delivery a useful framework for contracting. It provides a clear picture of the level of LNG-fuelled preparedness of their vessel, as well as guidance on the scope of the contemplated work for all involved parties.

The basic notation with the qualifiers D and MEc – Gas ready (D, MEc) – verifies that the vessel is in compliance with the gas-fuelled rules in terms of its overall design for future LNG fuel operations and that the main engine can be converted or can operate on gas fuel. The owner can also choose to add extra optional levels to the newbuilding under the notation. These cover selections such as structural reinforcements and the choice of correct materials to support future LNG tanks (S), preparations for future gas fuel systems (P), certification and installation of LNG fuel tanks (T), and the installation of machinery, which can be converted gas fuel, or which is already capable of burning gas fuel - putting the vessel further along the LNG track and thereby speeding up and simplifying a later conversion.
The clear certification and documentation requirements, efficient supporting calculation tools and a significantly increased list of approved suppliers are all important aspects of how the new rules will simplify working with DNV GL.

Clear certification and documentation requirements
The rules now contain an improved overview of the required documentation and required certification of materials and components. For easy application, documentation and certification types are consistently defined throughout the rules. All of the documentation requirements are summarized in a standardized table - supplemented with detailed description of the required content.

Information codes are used to easily identify which documents should be submitted to the society or are covered as part of DNV GL type approval. These codes also give a clear categorization of documents to be handled by the surveyor and which should be provided upon request. Certification requirements are defined to describe the products to be certified and how the certification should be documented.

These changes provide shipyards a better overview of documentation and certification requirements, easing their order and construction practice.

Certification of Materials & Components
Material and component suppliers certified by either GL or DNV (or both) will receive certification under one regime. Consequently, there will be an increased number of certified suppliers worldwide for the DNV GL rules, which will extend the available product/material portfolio. This gives manufacturers, yards and designers more flexibility in selecting products.

Learn more at dnvgl.com/dnvglrules
Efficient calculation tools are essential in the development of ship designs. The new DNV GL rules for hull structure are supported by both the POSEIDON and the Nauticus Hull software tools. These already have a strong reputation and have received major updates to provide efficient support and ease the application of the new rules.

Powerful tools to enable an efficient design process
The new DNV GL rules are based on new advanced load concepts with state-of-the-art capacity models. This will give a more realistic representation of the environmental loads and vessel experiences while laying the foundation for a consistent and efficient structural design assessment. DNV GL is committed to investing in the rule calculation tools to provide our customers with efficient support for the new rules.

DNV GL calculation tools – key priorities
Both the Nauticus Hull and POSEIDON packages are updated to support the new DNV GL rules for prescriptive and finite-element calculations. Better modelling capabilities and automation of calculation tasks, together with improved result processing and reporting functionalities, improve efficiency and the overall quality. In addition, it has been important to further develop how the tools exchange models with yard design and FE systems.

Prescriptive calculations
The new releases support the new rule formulations with enhanced functionality, allowing the engineer to get a better understanding of both the structural design and the underlying rule requirements. The toolbox for prescriptive calculations includes:

- Rule calculator functionality for local scantling checks of primary supporting members and individual assessment of plates and stiffeners
- Cross section analysis with enhanced overview of rule compliance and support for design iterations
- Grillage tool with new functionality for automatic application of loads and rule check
- Import of 2D drawings for better support for geometry and structure modelling with link to rule calculator to run calculations of plates and stiffeners directly on drawing

Grillage in 3D Beam with link to rule calculator for application of loads and prescriptive rule check

Automatic buckling check in GeniE
Finite Element Analysis

Direct strength calculation by Finite Element Analysis (FEA) is increasingly important in the design and approval process. FEA support in Nauticus Hull/GeniE and POSEIDON has received a major update including:

- New functionality for ship-specific modelling and import of hull form from 3D design tools for efficient modelling of the non-parallel cargo area
- Improved mesh control with functionality for partial meshing and state-of-the-art tools for manual mesh adjustments
- Screening of the FE model to identify critical areas and improved efficiency for generating local fine mesh FE models of critical details
- Automatic generation of corrosion additions, boundary conditions and loads for cargo-hold FEA, including both local pressures and global hull girder loads
- Automatic yield, buckling and fatigue check according to the new rules. Acceptance criteria for different structural components are automatically accounted for
- Improved functionality for import of FE models from other FE systems (Patran/Nastran, ANSYS) and early design tools (NAPA Steel, AVEVA Marine)

Learn more at dnvgl.com/dnvglrules
A UNIQUE BLEND OF QUALITY, SERVICE AND EXPERIENCE

DNV GL is continuously developing new ways of supporting our customers to enhance safety, reduce downtime and optimize performance. With approximately 13,000 ships in class and about 2,200 ship surveyors worldwide making 15,000 on-board visits every year, we have access to one of the world’s largest fleets and an unrivalled experience database.

Through our classification services, support and consultancy activities, we gain unique insights and hands-on experience related to technical, operational and regulatory challenges. We continuously process this information in order to provide the best possible advice and support to our customers.

An important part of this support is to ensure that our rules reflect real operational experience and address critical areas accordingly. It also provides DNV GL with the best basis to develop additional class notations and advisory services, addressing specific needs in the industry.

DATE
We offer our customers direct access to technical experts (DATE). More than 400 experts covering all technical disciplines in centres around the world are ready to answer your questions - regardless of time zone - within one working day. Customers receive technical support set-up from a pool of experts located in Hamburg, Oslo, Singapore, Piraeus and Houston. All offices work together as a single point of contact to give customers the experience of seamless cooperation between our experts.

My DNV GL
The My DNV GL customer portal gives you easy access to our digital services as well as exclusive information. From your own customized account, you can use the intuitive interface to order surveys and audits, have an overview of certificates and reports, download survey preparation notes, manage your ISM audits and receive automatic alerts and class status reports, all while having full control of users and vessel access.

With our electronic approval service (eApproval), you can also upload documentation for approval, view the status of your submitted documents and download approved documents - anytime, anywhere in the world. Upload your technical documentation for type approval or for product certification of components for new ships and vessels in service.

As the world’s leading classification society, the depth of technical expertise that we are able to offer to our customers is unmatched, and we want to make sure that they can tap into this resource more easily than ever before.

Learn more at my.dnvgl.com
180 customer meetings and events

800 stakeholders approached for input/comment

2×150 years combined experience

1 rule set

8 rule books covering different regimes

38 ship type class notations 72 additional class notations

400 DNV GL experts ready to answer your questions 24 hours a day - backed up by DATE

27+ joint industry projects already initiated

300 stations globally
Regional Maritime offices

Americas
1400 Ravello Dr.
Katy, TX 77494
USA
Phone: +1 2813961000
houston.maritime@dnvgl.com

Greater China
1591 Hong Qiao Road
House No.9
200336 Shanghai, China
Phone: +86 21 3208 4518
marketing.rgc@dnvgl.com

North Europe
Johan Berentsens vei 109-111
Postbox 7400
5020 Bergen, Norway
Phone: +47 55943600
bergen.maritime@dnvgl.com

South East Europe & Middle East
5, Aitolikou Street
18545 Piraeus, Greece
Phone: +30 210 41 00 200
piraeus@dnvgl.com

Germany
Brooktorkai 18
20457 Hamburg, Germany
Phone: +49 40 361498786
region-germany.maritime@dnvgl.com

Korea & Japan
18F Kyobo Bldg.
Jong-ru 1, Jongno-gu
110714 Seoul, South Korea
Phone: +82 2 734 7326/7
region.korea@dnvgl.com

South East Asia & India
16 Science Park Drive
118227 Singapore
Singapore
Phone: +65 65 0 837 50
sing.fis@dnvgl.com

West Europe & Africa
3 Cathedral Street
Palace House
London, SE1 9DE
United Kingdom
Phone: +44 207 357 6080
london.maritime@dnvgl.com

DNV GL AS
NO-1322 Høvik, Norway
Tel: +47 67 57 99 00
www.dnvgl.com

DNV GL - Maritime
Brooktorkai 18
20457 Hamburg, Germany
Tel: +49 40 36 149 0
www.dnvgl.com/maritime

DNV GL
Driven by our purpose of safeguarding life, property and the environment, DNV GL enables organizations to advance the safety and sustainability of their business. We provide classification and technical assurance along with software and independent expert advisory services to the maritime, oil & gas and energy industries.

We also provide certification services to customers across a wide range of industries. Combining leading technical and operational expertise, risk methodology and in-depth industry knowledge, we empower our customers’ decisions and actions with trust and confidence. We continuously invest in research and collaborative innovation to provide customers and society with operational and technological foresight. With origins stretching back to 1864, DNV GL’s reach today is global. Operating in more than 100 countries, our professionals are dedicated to helping customers make the world safer, smarter and greener.