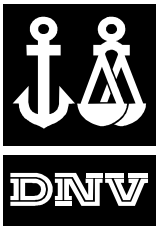

CERTIFICATION NOTES

No. 2.9

Type Approval Programme No. 4 - 703.10 - 1

TYPE APPROVAL PROGRAMME FOR STEERING GEAR

NOVEMBER 1995

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FOREWORD

DET NORSKE VERITAS (DNV) is an autonomous and independent Foundation with the object of safeguarding life, property and the environment at sea and ashore.

DET NORSKE VERITAS CLASSIFICATION AS (DNVC), a fully owned subsidiary Society of the Foundation, undertakes classification and certification and ensures the quality of ships, mobile offshore units, fixed offshore structures, facilities and systems, and carries out research in connection with these functions. The Society operates a world-wide network of survey stations and is authorised by more than 120 national administrations to carry out surveys and, in most cases, issue certificates on their behalf.

Certification Notes are publications which contain principles, acceptance criteria and practical information related to the Society's consideration of objects, personnel, organizations, services andoperations, in connection with issuance of certificates or declarations, which are not necessarily related to classification.

An updated list of Certification Notes is available on request. The list is also given in the latest edition of the Introduction-booklets to the"Rules for Classification of Ships", the"Rules for Classification of Mobile Offshore Units" and the"Rules for Classification of High Speed and Light Craft".

In "Rules for Classification of Fixed Offshore Installations", only those Certification Notes which are relevant for this type of structure have been listed.

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1. Type approval programme for steering gear

1.1 Scope

Type Approval is a procedure for certifying that the design of a product type is in conformity with a set of predetermined requirements.

This Type Approval programme contains the requirements on which Det Norske Veritas normally bases its Type Approval of hydraulic and electro-hydraulic **steering gears** intended for steering of ships, light crafts and mobile offshore units.

The requirements are based on the Rules for Classification of Ships and Mobile Offshore Units.

Type approval may be requested for a complete steering gear, or for a part of it e.g. rudder actuator.

The procedure for assessment of conformity of manufactured products (production) and the installation on board is not within the scope of the Type Approval Programme.

A type approval may however, contain certain requirements which are to be taken into account during installation on board the vessel, such as fixing to the rudder stock and steering gear foundation.

These requirements will have to be transfered to the product certificate for the steering gear in order to reach the building yard.

Guidance:
Per definition **steering gear** consists of :
The machinery, rudder actuator(s), steering gear power units and auxiliary equipment and means of applying torque to rudder stock (e.g. tiller or quadrant) necessary for effecting movement of rudder for purpose of steering a ship

The **rudder actuator** consists of :
the component which converts directly hydraulic pressure into mechanical action to move a rudder

2. Conformity assessment of design of product type

2.1 Procedure

The Type approval procedure consists of the following elements :

- Design assessment
- Type testing
- Certification retention survey

2.2 Documents to be submitted

Drawings (triplicate) and data showing all design details and materials are to be submitted together with application for type approval. Following data and information shall be given:

- intended field of application (e.g. ships, oil tankers > 10.000 GRT, etc.)
- design data (design pressure, working pressure, torque capacity, max rudder angles, load limits for axial and radial support forces, etc.)
- ranges for pump capacity- oil capacity (total and in each system)
- functional description

The drawings are to include at least:

- An arrangement drawing and a sectional drawing of the assembled unit drawn to scale and
- a schematic block diagram showing entire steering arrangement, hydraulic function and piping diagrams for system solutions as applicable.

Individual part drawings are necessary when details as stress raisers, important dimensions and material data are not given on the sectional or assembly drawing.

Drawings of pumps, valves and other piping components need not to be submitted, unless of a novel design. Electrical control and instrumentation components are subject to (type) testing. All such items are to be listed in part list with necessary information about maker and type designation. Type approved components are preferred.

Operating instructions are adviced to be submitted together with the above documents. These instructions shall show a schematic block-diagram of the entire steering gear inclusive any steering arrangement on the bridge and a simple way give information about the procedures for normal steering, steering in case of any failure and for the emergency steering. Any additional steering position on the bridge shall be shown in the block diagram and instruction shall be given about the priority (if any) between the different steering positions and also possible limitations. The operating instructions are required to be posted on board (nav. bridge and steering gear compartment).

Finite element (FEM) analysis are normally required only for parts of complex design. Strain gauge measurements may be required as supplementary to FEM analysis.

For **non-duplicated rudder actuators**, intended for installation on board tankers of 10.000 Grt to 100.000 DWT, following analysis are normally to be submitted:

- analysis showing suitability of the design for intended service
- detailed stress analysis of pressure retaining parts

– for a complex design or production process fatigue and fracture mechanical analysis may be required

Failure mode and effect analysis is to be submitted for hydraulic systems and for steering control systems.

A complete test procedure for the type testing and evaluation of results is to be submitted.

2.3 Material requirements

Materials are to comply with DNV Rules Pt.2 with additional requirements given in Pt.3 Ch.3 and for electrical and instrumentation components in Pt.4 Ch.4 and 5.

Alternatively, other specifications such as national / international standards, manufacturer's specifications etc. may be used as a basis for Type Approval. If this shall apply, the full specification is to be submitted. It must describe all relevant requirements and testing.

2.4 Design requirements

2.4.1 Functional requirements

Functional requirements for steering gear are given in Pt.3 Ch.3 and concern performance capacity and functional safety. Reliability and availability of any single components will be specially considered.

Main principal is that a single failure in one part or system shall not render the other one(s) ineffective. Tiller or quadrant are excepted from this requirement. Time for regaining steering capability after a single failure is a matter, which will be evaluated as function of the intended field of application.

Compliance with capacity requirements given in the rules will always be verified after installation on board at sea trial and will be given as a condition for the type approval.

2.4.2 Design strength

The rudder actuator parts will be evaluated with regard to strength equivalent to the DNV requirements in Pt.3 Ch.3. Following load cases will be considered:

1) Forces based on Rule rudder force and torque to be transmitted from the rudder stock via steering gear and it's the foundation to hull structure
2) Forces generated by internal hydraulic pressure corresponding to design pressure
3) Specified load limits for design

A rudder actuator may normally be type approved for a certain diameter range of rudder stock based on it's mechanical strength and max. available torque. An upper limit, usually given as "Max. permissible rule rudder stock diameter", will be defined based on strength of the actuator and it's connections to a foundation. Basic rule principle: "at least equivalent strength with rule rudder stock in way of tiller" applies. The lower limit will be defined from strength of the rudder stock and max. torque of the actuator at design pressure.

A non-duplicated rudder actuator, intended for installation on board oil tankers, chemical carrier or liquefied gas carriers of 10.000 GRT and more (but less than 100.000 DWT) is to comply with IMO Guidelines. Ref. Appendix A in Pt.3 Ch.3.

Such actuator is subject to thorough analysis with respect to both high cycle and cumulative fatigue and suitability of individual components.

2.5 Requirements to identification of product type with certificate

The product is to be provided with visible marking giving at least the following information :

– Manufacturer's name or trade mark
– Technical data necessary for the application
– Type designation under which the product is type approved

The marking is to be carried out in such a way that it is visible, legible and indelible throughout the anticipated life of the product, and that the marks can be traced back to the Type Approval Certificate.

2.6 Elements of Type Approval

2.6.1 Design assessment

The design assessment is carried out to assess that the design of the product is in conformity with given design requirements stated in item 2.4.

2.6.2 Type testing

The main objective of the Type Testing is to verify properties which cannot be verified by analyses and calculations with reasonable reliability. This includes the following :

– to ensure that assumptions and conditions forming the basis for design are complied with
– to ensure satisfactory strength, stiffness, functional capability and reliability
– to form a basis for the production testing.

Type testing may also include special tests, such as burst test for determination of strength instead of theoretical stress analysis.

Each type of steering gear power unit pump is to be subjected to a type test.

Corrosion resistance test may be required for steering gear parts exposed to contact with sea water. E.g. actuators intended for water jets.

Pipe couplings of compression and bite ring type and flexible hoses are to be type tested.

Extent of type testing may be reduced, or type testing may be waived, based on documented operational experiences with the actual steering gear, or with a similar type. Such experience data shall in addition to number of units and service years, contain information about ship types and sizes. Service experiences shall be documented and shall include written statements from users. Any changes of design must be given (what and when).

2.6.2.1 Testing equipment

On the test rig the following parameters are to be adjustable:

- oil pressure
- oil flow

The following are normally to be measured:

- oil pressure in high and low pressure sides
- oil flow
- turning speed
- current (electric motor)

Following optional parameters may also be required measured:

- oil flow as function of time (valve characteristics)
- strain gauge measurements of stresses
- deflections
- torque (usually by strain gauges)
- corrosion resistance

For type testing of pipe couplings and flexible hoses see separate publication.

2.6.3 Type Approval Certificate

When the design assessment and type testing are successfully completed a Type Approval Certificate will be issued to the manufacturer for the conformity of the design of the product type.

The Certificate is given a validity period of normally 4 years.

2.6.4 Certificate retention survey

The scope of the Type Approval Certificate retention survey is to verify that the conditions stipulated for the Type Approval is complied with and that no alterations are made to the product design or choice of materials.

If regular DNV product certification of steering gears takes place during the validity period of the Type Approval Certificate, the Type Approval Certificate retention survey can be combined with the product certification survey.

The main elements of the Type Approval Certificate retention survey are:

- Witnessing of tests/inspection on factory samples, selected at random from the production line.
- Review of type approval documentation.
- Review of possible changes in design, materials and performance.
- Ensure traceability between manufacturer's product type marking and Type Approval Certificate.

2.6.5 Renewal of Type Approval Certificate

At least three months before the periode of validity expires, the certificate-holder has to apply for renewal of the certificate.

Upon receipt of the request for renewal, Det Norske Veritas will perform a renewal survey which has the same content as the certificate retention survey as stasted in item 2.6.4.

The survey report will constitute the basis for renewal of the Typ Approval and the issuance of a new certificate.

3. Conformity assessment of manufactured products (production)

3.1 Product Certificates

Each steering gear is to be delivered with product certificate when intended for DNV classed vessels.

The requirements to inspection and testing as well as which kind of certificates to be used for the various parts are laid down in the Rules Pt.3 Ch.3.