DNV·GL

Certificate No:
TAM00000NF

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Hydraulic Rudder Actuator for Steering Gear

with type designation(s)
RV-450-2, RV-550-2, RV-650-3, RV 850-3

Issued to
Rolls-Royce Marine AS
BRATTVÅG, Norway

is found to comply with
DNV GL rules for classification – Ships
DNV GL rules for classification – High speed and light craft

Application :

Can be used for all steering gears which according to current rules may be provided with single rudder actuator, including compliance with Appendix A.

Product(s) approved by this certificate is/are accepted for installation on all vessels classed by DNV GL.

Issued at **Høvik** on **2018-02-01**
This Certificate is valid until **2022-06-30**.
DNV GL local station: **Ålesund**

Approval Engineer: **Svein-Olav Hannevik**

for **DNV GL**

Oddvar Deinboll
Head of Section

This Certificate is subject to terms and conditions overleaf. Any significant change in design or construction may render this Certificate invalid.
The validity date relates to the Type Approval Certificate and not to the approval of equipment/systems installed.

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Job Id: **262.1-006848-6**
Certificate No: **TAM00000NF**

Product description
Type of actuator: Hydraulic rotary vane

Application/Limitation
The approval includes the rudder actuator and hydraulic system.

	RV 450-2	RV 550-2	RV 650-3		RV 850-3		Unit
Max design pressure	100	100	100		100		bar
Max safety valve set	100	100	100		100		bar
Max working pressure	80	80	80		80		bar
Test pressure	150	150	150		150		bar
Max design torque	537	710	805		1066		kNm
Max working torque	430	568	644		853		kNm
Max rule rudder torque	430	568	644		853		kNm
Max rudderstock Ø	360	370	390		420		mm
Min rudderstock Ø [1]	271	297	310		341		mm
Max rudder angle	2x71,5	2x71,5	2x37,5	2x46,5	2x37,5	2x46,5	deg
Housing/cover [2]							
Min. tensile strength	400	400	400	400	400	400	N/mm^2
Min. yield strength	240	240	240	240	240	240	N/mm^2
Min. elongation	12	12	12	12	12	12	%
Rotor [2] [3]							
Min. tensile strength	400	400	400	440	400	460	N/mm^2
Min. yield strength	280	280	280	290	280	320	N/mm^2
Min. elongation	12	12	12	12	12	12	%
Max Pump capacity [4]	1550	1550	1550		1550		l/min
Max radial force	1400	1400	1400		1400		kN
Max axial force	500	500	500		500		kN

1. Based on yield strength in rudder stock equal to 235 N/mm^{2}and rudder stock deflection due to bending moment i.w.o. the upper bearing less than twice the diametrical bearing clearance. (Pt.4 Ch.10 Sec.1 [2.11.20]) However, minimum rudderstock diameter will normally be limited by requirement with respect to fitting of steering-gear to rudderstock (not included in type approval).
2. For non-duplicated rudder actuators for oil, chemical and liquefied gas carriers of 10 000 gross tonnage and upwards, but less than 100 000 tdw (Pt.4 Ch.10 Appendix A), the following material requirements apply:
   Housing/cover: Yield strength 280 N/mm^2, Tensile strength 460 N/mm^2, Min. elongation 12%
   Rotor: Yield strength 310 N/mm^2, Tensile strength 460 N/mm^2, Min. elongation 12%
   Magnetic particle testing (MT) is required for all machined surfaces of the housing and cover.
3. Provided that tangential shrink fitting stress at the outer hub surface is less than 115 N/mm^2 (Pt.4 Ch.10 Sec.1 [2.11.16]). Otherwise vane stress must be specially considered (i.e. case by case approval).
4. Stated value is per pump. Changes in pump capacities may lead to required change in relief valve capacity (see Pt.4 Ch.10 Sec.1 [2.10.6]). Valve characteristics shall then be submitted.

Type Approval documentation

Drawing No.	Rev.	Title

Marking of product
The product shall be marked with manufacturer's name or trademark and type number identification.

Periodical assessment
For retention of the Type Approval, a DNV GL surveyor shall perform an assessment after 2 years and after 3.5 years to verify that the conditions of the type approval are complied with. A renewal assessment will be performed at renewal of the certificate.

In cases where the Type Approved product is manufactured at other companies, the Periodical Assessment shall verify that the Type Approval applicant has a quality control system for consistent production at their licensees/subcontractors. Furthermore Periodical Assessment shall be carried out randomly at these companies.

Other conditions
A steering test is to be carried out under normal working conditions to demonstrate compliance with requirements in Pt.4 Ch.10 Sec.1 [9].

For approval of the complete steering gear the following shall be submitted case-by-case:
- Technical data sheet
- Pump capacity and relief valve capacity
- Hydraulic diagram with list of alarms and set points
- Arrangement drawing of steering gear
- Calculation of connection to rudderstock
- Mounting and operation instructions to follow each delivery

- Operation instructions for all operation modes including local control (Yard supply)
- Foundation and mounting arrangement, including bolting and chocking calculations (Yard supply)
- Arrangement of steering gear compartment (Yard supply)

Deflections of rudderstock due to rudder force may have the following consequences - which need to be considered:
- Deflections exceeding bearing clearances will induce an additional bending moment in rudderstock (Pt.4 Ch.10 Sec.1 [2.11.21])
- Increased bearing loads and friction losses
- Increased pressure in the connection between rudderstock and rotor

END OF CERTIFICATE