Certificate No:
TAP00002N9

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Hydraulic Cylinders

with type designation(s)
DVLRS

Issued to
MacArtney Hydraulics A/S
Lemvig, Midtjylland, **Denmark**

is found to comply with
DNV standard DNV-ST-0194 – Hydraulic cylinders
DNV rules for classification – Ships Pt.4 Ch.6 Piping systems

Application :

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

Design pressure (push)	**250 bar (see certificate)**
Design pressure (pull)	**250 bar**
Cylinder sizes	**see certifcate**

Issued at **Høvik** on **2023-02-10**

This Certificate is valid until **2028-02-09**.

for **DNV**

DNV local unit: **Sweden CMC**

Approval Engineer: **Jane Lozanov**

Bosman van der Merwe
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.

LEGAL DISCLAIMER: Unless otherwise stated in the applicable contract with the holder of this document, or following from mandatory law, the liability of DNV AS, its parent companies and their subsidiaries as well as their officers, directors and employees ("DNV") arising from or in connection with the services rendered for the purpose of the issuance of this document or reliance thereon, whether in contract or in tort (including negligence), shall be limited to direct losses and under any circumstance be limited to 300,000 USD.

Product description

4 types of double acting hydraulic cylinders designed according to DNV-ST-0194.

Dimensional data:

Type	Outside diameter	Inside diameter	Piston rod diameter	Stroke
DVLRS 63/40-550 (+125)	83 mm	63 mm	40 mm	550 mm*
DVLRS 160/110-1230 (+153)	200 mm	160 mm	110 mm	1230 mm
DVLRS 110/56-590 (+190)	140 mm	110 mm	56 mm	590 mm**
DVLRS 40/25-195	60 mm	40 mm	25 mm	195 mm

* From stroke 485 mm to 550 mm: 205 bar
** From stroke 575 mm to 590 mm: 240 bar

Materials:

Type	Cylinder tube	Piston rod	Piston	Rod eye	Tube end	Stuffing box
DVLRS 63/40-550 (+125)	E355+SR (EN10305-1)	1.4418 +QT900 (EN 10088-3)	S355J2+N* (EN10025-2)	S355J2+N* (EN10025-2)	S355J2+N*/** (EN10025-2)	1.4404 (EN10272)
DVLRS 160/110-1230 (+153)	E355+SR (EN10305-1)	1.4418 +QT900 (EN 10088-3)	S355J2+N* (EN10025-2)	S355J2+N* (EN10250-2)	S355J2+N* (EN10250-2)	S355J2+N* (EN10025-2)
DVLRS 110/56-590 (+190)	E355+SR (EN10305-1)	1.4418 +QT900 (EN 10088-3)	1.4418 +QT900 (EN 10088-3)	S355J2+N* (EN10025-2)	S355J2+N* (EN10250-2)	S355J2+N* (EN10025-2)
DVLRS 40/25-195	E355+SR (EN10305-1)	1.4460 (EN 10088-3)	S355J2+N* (EN10025-2)	1.4418 +QT900 (EN 10088-3)	S355J2+N*/** (EN10025-2)	1.4404 (EN10272)

* The material shall be fine grain treated according to DNV-RU-SHIP Pt.2 Ch.2 Sec.2 [2.6.6], RU-SHIP Pt.2 Ch.2 Sec.3 [1.5.3].
** If the end cover is made from rolled plate it is to be tensile tested in the Z-direction.

Application/Limitation

Design temperature(min/max): -20°/50°C

Test pressures:

Type	Pull/Push
DVLRS 63/40-550 (+125)	375 bar
DVLRS 160/110-1230 (+153)	
DVLRS 110/56-590 (+190)	
DVLRS 40/25-195	

The following cylinders are limited to the following number of full load cycles over the life span:

Type	Number load cycles
DVLRS 63/40-550 (+125)	55600
DVLRS 160/110-1230 (+153)	42100
DVLRS 110/56-590 (+190)	17700
DVLRS 40/25-195	206000

The hydraulic cylinders are not intended to operate under emergency conditions.

All welding is to be carried out by qualified welders and according to approved welding procedures. Non-destructive testing of all welds is to be performed according to DNV-ST-0194 [2.3] - Hydraulic Cylinders.

Cylinder tube, piston rod, end covers, and end connections shall be Charpy-V impacted tested at minimum design temperature. Minimum specified average energy value shall be according to DNV-ST-0194 [2.1.1].

Type Approval documentation

Production test and Certification

Each cylinder is to be hydraulically pressure tested to 1.5 times of the design pressure and be delivered with a DNV product certificate. The test pressure is to be applied on both sides of the piston in sequence. Testing are to be in accordance with to DNV standard ST-0194 - Hydraulic Cylinders in presence of DNV surveyor.

Materials for cylinder tube, piston rod, end covers and end eyes shall be delivered with 3.1 material certificates.

Marking of product

Hydraulic cylinders shall be permanently marked in order to enable unique traceability to a product certificate or a type approval certificate. The marking shall at least consist of the following:

- manufacturer's name or trade mark
- type designation
- DNV product certificate number, if applicable
- charge number for the materials used in the cylinder tube and the piston rod.

Periodical assessment

For retention of the Type Approval, a DNV Surveyor shall perform periodical assessment after two years (+/- 90 days) and after 3.5 years (+/- 90 days) to verify that the conditions for the approval are complied with. Reference is made to DNV-CP-0338.