

TYPE APPROVAL CERTIFICATE

This is to certify:

That the **Positive Displacement Pumps - Reciprocating**

with type designation(s)
SG 50 (cold end), SG 80 (cold end)

Issued to

Fives Cryomec AG
ALLSCHWIL, Switzerland

is found to comply with

DNV GL rules for classification – Ships Pt.5 Ch.7 Liquefied gas tankers
DNV GL class programme DNVGL-CP-0505 – Type approval – Pumping units

Application :

Products approved by this certificate are accepted for installation on all vessels classed by DNV.

Type	Max. working press.:	Operating media:	Temperature range:
SG 50 (cold end)	500 bar	LNG, Liquid ethane, Liquid nitrogen (LIN)	-165°C to +50°C
SG 80 (cold end)	400 bar	LNG, Liquid ethane, Liquid nitrogen (LIN)	-165°C to +50°C

Issued at **Hamburg** on **2021-05-18**

This Certificate is valid until **2026-05-17**.

DNV local station: **Essen**

Approval Engineer: **Guido Friederich**

for **DNV**

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Olaf Drews
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

High pressure cryogenic reciprocating pumps type SG 50 and SG 80 (cold ends) which may be connected to a crankshaft section driven by an electric motor¹ (hot end).

The crankshaft drive section converts the rotatory drive motion into a stroke actuation for the reciprocating cold end pump.

Depending on the required operating pressure and amount of liquid natural gas volume flow rate two different cold end pump types SG 50 or SG 80 are available for installation on the drive section.

In addition, two or three cold end pumps may be combined as a twin or triple pump unit on one crankshaft drive section.

This type approval covers cold end cryogenic pump types SG 50 and SG 80 only.

Design data SG 50, SG 80 high pressure pump

Design features	SG 50		SG 80	
Design temperatures ²	-165°C to + 50°C	°C	-165°C to + 50°C	°C
Speed	1,2	m/s	1,2	m/s
Maximum suction pressure	16	bar	16	bar
Maximum discharge pressure	500	bar	400	bar
Flow rate	60	lpm	154	lpm

SG 50 and SG 80 Materials (extraction)

Part	Material specification
Cylinder	1.4404 / EN 10272
Inner cylinder liner	1.4034 / EN 10088-3
Outer cylinder liner	1.4404 / EN 10272
Piston stem	1.4404 / EN 10272
Piston head	CuSn12-G-GC / EN 1982
Flange	1.4404 / EN 10272
Stud bolt	A4-80 / EN 3506-1
Nut	A4-80 / EN 3506-2

¹: Electric motors for pump drive including other electrical equipment necessary for pump operation shall be provided with respective DNV GL (type) approvals for installation on board of DNV GL classed ships.

²: Test temperature amounts to -196°C, used for test with liquid nitrogen (LIN)

Application

Installation as a cryogenic (LNG) fuel supply pump in gas fuel systems.

Approved operating media: Liquefied gases (LNG), liquid ethane, liquid nitrogen (LIN)

Limitation

If the pump is used on board of a vessel with a cargo temperature below -165°C, the requirements for design temperatures below -165°C shall be specially agreed with the flag state administration.

Tests carried out

Pump performance test carried out within an installation in a MAN Pump Vaporizer Unit (PVU)
Type of cryogenic pump specimen tested for reference: SG 80 pump type

Test standards: DNV GL Rules Pt.5 Ch.7 – Liquefied gas tankers DNV GL CP 0505 – Pumping units for liquids MAN General Guideline for Factory Acceptance Test of PVU System	
Type of Test	Scope of test
Hydrostatic test SG 80 pump performance test. Test medium: Liquid nitrogen Test temperature: -196°C [-321°F] Recorded operating data	Test pressure in amount of 1,5 times the design pressure. Volume flow rate [m3/hr] Pump frequency [Hz] Suction pressure [bar] Discharge pressure [bar]
Visual inspection of SG 80 pump	Visual inspection with satisfactory results on accordance with drawings, assembly quality, satisfactory fabrication of single parts. Review of material certificates
Performance and results of tests	All visual inspections and tests witnessed by a DNV GL Surveyor Tests performed with positive results without objections

Type Approval documentation

Marking of product

For traceability to this type approval the SG 50 and SG 80 pump types are to be marked with:

- Manufacturers name or trademark
- Pump type designation
- Size
- Design pressure and temperature

Periodical assessment

For retention of the Type Approval, a DNV GL Surveyor shall perform periodical assessment to verify that the conditions for the Type Approval are complied with. Refer to the Class Programme DNVGL-CP-0338, Sec.4.

To check the validity of this certificate, please look it up in <https://approvalfinder.dnvgl.com>

End of certificate