Certificate No:
TAP00002B7

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Pumps

with type designation(s)
MSP-GU / GUPD

Issued to
Nikkiso ACD
Santa Ana, CA, USA

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.

Max. working press.:	**448 bar [6500 psig]**
Operating media:	**Liquefied gases (LNG), liquid ethane, liquefied nitrogen (LIN)**
Temperature range:	**-165°C to + 65°C [-265° F to 149°F]**

Issued at **Hamburg** on **2021-03-11**
This Certificate is valid until **2026-03-08**.
DNV local station: **Long Beach**

Approval Engineer: **Guido Friederich**

for **DNV**

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.

Product description

ACD high pressure cryogenic reciprocating pump type MSP-GU / GUPD consisting of an electric motor[1] driven crankshaft section (hot end) and the direct connected reciprocating cryogenic pump (cold end). The crankshaft drive section converts the rotatory drive motion into the stroke actuation for the reciprocating pump. Depending on the required amount of cryogenic fuel supply one, two or three cold end pumps may be combined to a pump unit on one crankshaft.
This type approval covers the cold end cryogenic pump only. Documentation of the crankshaft drive section has been reviewed for information.

Design data MSP-GU / GUPD high pressure pump

Design features	Data (SI)		Data (US imperial)	
Design temperatures[2]	-165°C to + 65°C	°C	-265° to 149°	°F
Speed range	100 to 940	rpm	100 to 940	rpm
Maximum discharge pressure	448	bar	6500	psig
Pump design power rating	153	kW	205	hp
Flow rate	17,0 to 185	lpm	4,5 to 48,8	gpm
Stroke	33,02/ 38,1	mm	1,3 / 1,5	inch
Piston Diameter	50,8	mm	2	inch

Materials (extraction)

Part	Material specification
Cylinder assembly	ASTM A276 316 SST
Discharge fitting	ASTM A276 316 SST
Pump head	ASTM A564-89 17-4 PH, H1150M
Sleeve cylinder	ASTM A276-98b, Rc 50-55

[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 [320°F], 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.

Type Approval documentation

Tests carried out

Test standards: DNV GL Rules Pt.5 Ch.7 – Liquefied gas tankers DNV GL CP 0505 – Pumping units for liquids Type of Test	Scope of test
Pressure test	Test pressure in amount of 1,5 times the design pressure.
MSP-GU / GUPD pump performance test. Test medium: Liquid nitrogen Test temperature: -196°C [-321°F] Recorded operating data	Volume flow rate [m3/hr] Pump power input [kW] Pump speed [min -1] Suction pressure (p1) [bar] Discharge pressure (p2) [bar]
Visual inspection of MSP-GU / GUPD 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

Marking of product

For traceability to this type approval the ACD MSP-GU / GUPD pumps 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

Certificate No:
TAP00002B9

TYPE APPROVAL CERTIFICATE

This is to certify:

That the Pumps

with type designation(s)
MSP-SL

Issued to
Nikkiso ACD
Santa Ana, CA, USA

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.

Max. working press.:	**414 bar [6005 psig]**
Operating media:	**Liquefied gases (LNG), liquid ethane, liquefied nitrogen (LIN)**
Temperature range:	**-165°C to + 65°C [-265° F to 149°F]**

Issued at **Hamburg** on **2021-03-11**
This Certificate is valid until **2026-03-10**.
DNV local station: **Long Beach**

Approval Engineer: **Guido Friederich**

for **DNV**

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.

Product description

ACD high pressure cryogenic reciprocating pump type MSP-SL consisting of an electric motor[1] driven crankshaft section (hot end) and the direct connected reciprocating cryogenic pump (cold end).
The crankshaft drive section converts the rotatory drive motion into the stroke actuation for the reciprocating pump. Depending on the required amount of cryogenic fuel supply one, two or three cold end pumps may be combined to a pump unit on one crankshaft.
This type approval covers the cold end cryogenic pump only. Documentation of the crankshaft drive section has been reviewed for information.

Design data MSP-SL high pressure pump

Design features	Data (SI)		Data (US imperial)	
Design temperatures[2]	-165°C to + 65°C	°C	-265° to 149°	°F
Maximum discharge pressure	414	bar	6005	psig
Speed range	100 to 1000	rpm	100 to 1000	rpm
Piston Diameter	50,8 | 64	mm	2 | 2,5	inch

Materials (extraction)

Part	Material specification
Cylinder assembly	ASTM A276 316 SST
Discharge fitting	ASTM A276 316 SST
Pump head	ASTM A564-89 17-4 PH, H1150M
Sleeve cylinder	ASTM A276-98b, Rc 50-55/ SS440-C

[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 gas, LNG, 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.

Type Approval documentation

Tests carried out

Test standards: DNV GL Rules Pt.5 Ch.7 – Liquefied gas tankers DNV GL CP 0505 – Pumping units for liquids Type of Test	Scope of test
Pressure test	Test pressure in amount of 1,5 times the design pressure.
MSP-SL pump performance test. Test medium: Liquid nitrogen Test temperature: -196°C [-321°F] Recorded operating data	Volume flow rate [m3/hr] Pump power input [kW] Pump speed [min -1] Suction pressure (p1) [bar] Discharge pressure (p2) [bar]
Visual inspection of MSP-SL 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

Marking of product

For traceability to this type approval the ACD MSP-SL pumps 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