# Nikkiso Clean Energy and Industrial Gases Group

Your global choice for innovative equipment and solutions in liquid gases and beyond.

Cryogenic Pumps Edition



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Nikkiso Cryo Centrifugal Pumps

### Nikkiso Cryogenic Industries Clean Energy and Industrial Gases Group

Nikkiso Cryogenic Industries Clean Energy and Industrial Gases Group was created from the March 2019 consolidation of Cryogenic Industries and Nikkiso Cryo, both subsidiaries of Nikkiso Co., Ltd. Japan. Working together with our shared experience, resources and commitment to quality, will allow us to focus more closely on our customers' needs, providing individual support, service and solutions.

The group consists of five functional units:

**Cryogenic Pumps** Aligns ACD's and Nikkiso Cryo's lines of pumps

Cryogenic Process Systems Incorporates turbo expanders along with LNG and Air Separation plants

#### Heat Exchanger Systems

Focuses on cryogenic vaporizers, LNG and industrial gas equipment

#### **Cryogenic Services**

Provides service and support through a broad network of global facilities

#### Integrated Cryogenic Solutions

Newly created to allow for centralized management of product and project development across channels and in multiple market segments

"One key benefit of our new business approach is the capacity to expand our offerings and provide a comprehensive product line for clean energy such as LNG and hydrogen, in addition to our existing line of products for industrial gases," said Peter Wagner, President and CEO of Cryogenic Industries.

Through joint research and innovation, the Group will provide increased engineering and systems solutions for market development.



# ACD Centrifugal Pumps

## Model AC-14M. Trailer Off-Loading Pump.



#### Specifications

Flow Range	gpm	20 – 200
	lpm	75 – 750
	feet	1.4 - 3.6
NPSHR	meter	0.42 – 1.1
	feet	440 - 690
	meter	135 – 210
Pump Design Rating	hp	30
	kw	22.5
Speed Range	rpm	6,900

Consult ACD engineering for actual performance ratings.

#### Features & Benefits

- XP Inducer improves NPSH required
- Gearbox design provides:
  - Improved efficiencies at higher speeds
  - Higher operating range (flows and pressures)
  - Splash oil lube system for improved bearing life and lower maintenance requirements
  - Reduced vibration and noise
- All parts interchangeable with comparable pump
- Stainless steel bearing house reduces "cold creep" into the gearbox

#### **Applications**

- Trailer off loading
- Liquid storage transfer

#### **Liquids Pumped**

- Nitrogen
- Oxygen
- Argon
- = LNG

#### Typical Scope of Supply

- Pump, high performance gearbox drive and TEFC motor with purge ports
- Splash lubricated gears
- Long life (CFS) mechanical seal
- IEC Motor frame

### Model AC-18. Boost Pump/Trailer Off-Load.



Right Hand Discharge $2 \times 3 \times 6 \& 2 \times 4 \times 6$ 



S	p	e	С	ifi	C	at	io	n	s
_		-	_						_

Flaw Danas	gpm	5 - 500					
Flow Range	lpm		20 - 1,900				
NDOUD	feet		3 – 35				
NPSHR	meter		2 – 10				
Differential Head	feet	40 - 780					
	meter		13 – 240				
	hp		1 – 85				
Pump Design Rating	kw	0.75 – 60					
RPM Range		1 x 2 x 4.5	1.5 x 2.5 x 6A	2 x 3 x 6	2 x 4 x 6		
	rpm	2,000-10,200	2,000-7,200	2,000-8,100	2,000-8,100		

**Left Hand Discharge** 1 x 2 x 4.5 & 1.5 x 2.5 x 6A

#### **Features & Benefits**

- Compact design is lightweight and reduces installation time
- Hydraulic drive allows operators to use truck pto system
- Bearing housing designed for well service, heavy duty applications
- Shaft seal features CFS design, extending seal life

#### **Applications**

- Well service
- Transfer boost pump
- Trailer off load

#### **Liquids Pumped**

- Nitrogen
- Methane
- Argon

#### Typical Scope of Supply

- Pump, bearing housing and hydraulic coupling
- CFS mechanical seal
- Purge ports

- Purge kit (bearings)
- Mating flanges

### Model AC/TC-21. Belt Box Configuration.



#### **Specifications**

	gpm	10 – 180
Flow Range	lpm	35 – 680
	feet	2 - 8
NPSHK	meter	0.6 - 2.5
	feet	100 – 1,100
	meter	30 – 335
	hp	5 – 30
Pump Design Rating	kw	3.75 – 22.5
Speed Range	rpm	2,000 - 8,400

Consult ACD engineering for actual performance ratings.

#### **Features & Benefits**

- Belt drive design allows for higher speeds
- Belt tension mechanism increases life of the timing belt and bearings
- Lightweight aluminum belt housing construction reduces overall pump weight
- Belt drive components have "full tooth engagement" for greater capacity and longer life
- Bearing purge ports are provided for liquid oxygen applications
- Cold end can be removed as a single piece, simplifying maintenance
- All bronze construction allows for O<sub>2</sub> compatibility

#### Applications

- Liquid storage transfer
- Liquid cylinder filling
- Trailer off-loading (ground mount)
- Test facility support
- Laboratory research

#### Liquids Pumped

- Nitrogen
- Oxygen
- Argon
- Methane

#### **Typical Scope of Supply**

- Pump, belt box, TEFC motor shown
- Grease packed bearings
- Motor purge ports
- Long life mechanical seal (CFS)

### Models TC-21(HD) and (J). Trailer Pumps.



#### Specifications

Flow Range	gpm	25 – 225
	lpm	95 – 852
	feet	3 – 10
NPSHK	meter	1 – 3.5
Differential Hand	feet	100 - 1,200
Differential Head	meter	31 – 366
Speed Range	rpm	1,500 – 5,500

Consult ACD engineering for actual performance ratings.

#### Features & Benefits

- State-of-the-art CFS mechanical seal for extended life
- High performance impeller provides a high flow rate with minimum NPSH required
- Machined heavy duty stainless steel shaft provides vibration free performance
- All bronze construction allows for oxygen compatibility
- Optional stainless intermediate and backplate reduces cold migration and prevents premature bearing failure

#### Applications

 Trailer off loading with hydraulic (HD) or jack shaft (J) drive

### Optional Accessories

- Stainless steel intermediate and backplate
- Speed pick-up and tachometer

#### **Typical Scope of Supply**

- Pump and bearing housing
- SAE-B flange to accept direct hydraulic motor mounting (HD only)
- Mounting brackets with locking tabs
- Port for speed verification
- Purge port (mechanical seal)

### Liquids Pumped

- Nitrogen
- Oxygen
- Argon
- Methane

### Model AC/TC-30. Close Coupled Pump.



#### **Specifications**

	gpm	16 – 630
Flow Range	lpm	60 - 2,350
	feet	2 – 12
NPSHK	meter	0.6 - 4
	feet	20 – 700
	meter	6 – 210
Pump Design Rating	hp	3 – 100
	kw	2.2 – 75
Speed Range	rpm	1,450 – 7,200

Consult ACD engineering for actual performance ratings.

#### **Features & Benefits**

- Close coupled design provides:
  - Operations at high efficiencies
  - Fewer moving parts
  - Lower maintenance costs
- Shaft seal design (mechanical, gas riding or labyrinth) are state-of-the-art and prolong life without leakage
- VFD compatibility allows for multiple operating speeds
- Minimum recirculation wear rings reduce maintenance requirements and improve efficiencies

#### **Applications**

- Liquid storage transfer
- Process plant
- Truck and trailer off-loading
- Tank car unloading

#### **Liquids Pumped**

- Nitrogen
- Oxygen
- Argon
- Methane

#### **Typical Scope of Supply**

- Pump and TEFC electrical motor shown
- Long life CFS mechanical seal
- Motor and seal purge ports

### Model AC-32. Vertical Sealless Pump.



#### **Specifications**

Flow Range	gpm	4 - 460
	lpm	15 – 1,514
NPSHR	feet	0.5 – 16
	meter	0.15 – 3.67
	feet	21 – 625
	meter	6.40 - 207
Pump Design Rating	hp	3 – 25
	kw	2.24 – 19
Speed Range	rpm	1,500 – 7,200

Consult ACD engineering for actual performance ratings.

#### Features & Benefits

- Pump and motor are fully flooded with liquid, minimizing start-up and downtime and guaranteeing quick, responsive pumping
- Sealless design minimizes maintenance requirements – no mechanical seal
- No sump required lowers cost
- Sealless zero leakage design is environmentally safe, releasing no volatile organic chemicals and contaminates (VOC's) into the atmosphere
- Multi-frequency motor provides an efficient and broad range of operation and power

- Electrical motor and bearing life is extended being cooled by the cryogen it is pumping, heat input is minimal and carried off by discharging liquid
- Low NPSH inducer coupled with a variable speed soft start motor eliminates cavitation at pump start-up
- Suitable for Class I, Div I (IEC Zone 0 and 1)
- Pass-thru connection

#### Applications

- LNG filling station pump
- Fuel loading pump
- LNG peaking plant

#### Liquids Pumped

- Nitrogen
- Argon
- Carbon Dioxide
- Methane (LNG)
- Ethylene (C<sub>2</sub>H<sub>2</sub>)

## Model TC-50. Belt Box Pump.



#### **Specifications**

Flow Down	gpm	20 – 200
Flow Range	lpm	75 – 750
	feet	2 – 12
NPSHK	meter	0.6 - 4
	feet	200 - 1,500
	meter	60 - 455
Pump Design Rating	hp	40 - 75
	kw	30 – 55
Speed Range	rpm	3,650 - 8,750

Consult ACD engineering for actual performance ratings.

#### Features & Benefits

- Rugged high speed belt box:
  - Excellent for intermittent duty, high power/flow applications
  - Design does not require an inverter duty motor to obtain high speed, high pressure applications
  - Excellent cold creep barrier to protect motor bearings
- Impeller design allows for low NPSH requirement
- All bronze construction allows for O<sub>2</sub> compatibility
- Mechanical seal (CFS) ensures long life
- Bearing/belt box purge ports provided for O<sub>2</sub> applications

#### **Applications**

- Liquid storage transfer
- Small and medium plant transfer and pipeline back-up
- Tank car unloading

#### **Liquids Pumped**

- Nitrogen
- Oxygen
- Argon
- Methane

#### **Typical Scope of Supply**

- Pump, TEFC motor, and high performance belt box drive shown
- Mechanical seal purge ports

- Pump skid assembly
- Bearing purge kit
- Spare parts kit

### TOP SERIES. Trailer Off-Loading Pumps.

**TOP 215** 



**TOP 7.6M** 2 x 3 x 7.6M

10

TOP 260 H 1.5 x 2.5 x 10

#### **Specifications**

Pump Size	Units	TOP 7.6M 2 x 3 x 7.6M	TOP 215 3 x 4 x 8.5	TOP 260 H 1.5 x 2.5 x 10
Elaw Data	gpm	10 – 180	50 – 950	25 – 290
Flow Rate	lpm	40 - 680	190 - 3,600	100 – 1,100
Differential Haad	ft	85 – 1,250	90 - 800	90 - 1,400
Differential Head	m	25 - 380	30 – 245	30 - 425
Maximum Working	psi	500	340	550
Pressure	bar	34	23	38
Maximum Power	hp	134	200	134
	kW	100	150	100
RPM Range	rpm	1,500 – 7,600	1,500 – 6,000	1,500 – 6,000

Contact ACD for specific performance data.



#### **Features & Benefits**

- Mechanical component seal design with composite face material
- Oil-lubricated bearing housing ensures lubricity of components and improves bearing life
- Cylindrical roller bearings strengthen capacity for lateral loads
- Hydraulic or jackshaft drive

#### **Liquids Pumped**

- Nitrogen
- Oxygen
- Argon
- = LNG

#### **Bearing Housing**

- Uses Hydrocarbon or Oxygen compatible oil
- Designed in compliance with CGA G-4.7 and EIGA/IGC 148/08/E guidelines for centrifugal oxygen pumps
- Up to 6,000 hours life—equivalent to 3 seal exchanges
- Best lubricated bearings in the industry

#### **Component Seal Exchange**

- Ease of installation reduces downtime
- Allows field exchange without removing the pump from the trailer
- Seal features composite face material
- No need to disconnect discharge piping

## Model TC-34. Submerged Motor Pump.



Not suitable for O2 service

#### **Specifications**

T. D.	gpm	2 - 400
Flow Range	lpm	8 – 1510
	feet	1.5 – 12
NPSHR	meter	0.5 – 4
	feet	50 - 1,600
	meter	15 – 488
	hp	10 up to 38
Pump Design Rating	kw	7.5 up to 34
RPM Range	rpm	1,500 – 7,200

Consult ACD engineering for actual performance ratings.

#### **Features & Benefits**

- Gastight design
- Pump and motor are fully submerged in liquid minimizing loss and guaranteeing quick response pumping
- Vacuum jacketed sump provides extremely low heat leak—ideal pumping conditions (optional)
- Sealess and submerged design minimizes maintenance requirements
- Vertical pump design provides greater stability and longer life
- Special design VFD motor provides broad range of operation

#### Applications

Use where product loss is not acceptable

- Liquid storage transfer
- Mobile delivery transfer LAR, LN<sub>2</sub>
- Vehicle fueling stations LNG

#### **Liquids Pumped**

- Liquid Nitrogen
- Liquid Argon
- Methane (LNG)

- Vacuum jacketed sump
- Variable frequency drive
- Differential pressure gauge
- Loss of prime detector (cavitation protection)
- Safety relief valve
- Dual conduit box per NFPA standards for LNG service

## Model TC-34.2. State-of-the-Art Submerged Motor Pumps.



Suction Pot Mounted Installation



In-tank and Removable Installations

#### **Specifications**

	gpm	1 - 1,600
Flow Range	lpm	4 - 6,056
NECLE	feet	0.5 – 5
NPSHR	meter	0.15 – 1.5
Differential Haard	feet	50 - 4,000
Differential Head	meter	15 – 1,220
Duran Danian Dation	hp	3.35 – 335
Pump Design Rating	kw	2.5 – 250
RPM Range	rpm	2,000 - 10,000

Consult ACD engineering for actual performance ratings.

#### Features & Benefits

- Active thrust balancing system for extended bearing life
- High efficiency hydraulics with extremely low NPSHR inducer
- Light weight and compact
- Available in sump and in-tank designs
- Special design VFD drive provides operation point control over the entire pump operating range
- Features a quick electrical disconnect for ease of maintenance
- Permanent magnet motor
- All parts from wrought aluminum precision machined
- Vacuum jacketed sump
- Heavy duty ceramic bearings

#### Applications

- Fuel supply systems for rail locomotives
- Low pressure marine fuel systems
- HP Booster pump
- Liquid storage transfer
- Bunkering operations
- Peak-shaving
- Trailer loading and off-loading
- High pressure pipeline injection
- Power generation

#### **Complete Pumping System**

- High-efficiency submerged pump
- Vacuum jacketed sump
- Custom made VFD drive factory string tested
- Dual electrical feed thru hermetically sealed up to 500A

#### Liquids Pumped

- Nitrogen
- Argon
- Ethylene
- Ethane
- Methane (LNG)
- Propane

- Differential pressure gauge
- Loss of prime detector (cavitation protection)
- Safety relief valve
- Dual conduit box per NFPA standards for LNG services
- Complete removal systems
- Long term storage container

### Vertical Turbine Pumps. State-of-the-Art Submerged Motor Pump.



### Specifications

	gpm	1,000 – 2,500
riow Range	lpm	3,785 – 9,462
NEOLE	feet	2 – 5 (162 – 2,800 gpm)
NPSHR	meter	0.6 – 1.5 (613 – 10,598 lpm)
	feet	46 - 1,937
Differential Head	meter	14 – 590
Pump Design Rating	hp	167.5 – 335
	kw	125 – 250
RPM Range	rpm	2,000 - 4,200

Consult ACD engineering for actual performance ratings.

#### VTK-240

#### Features & Benefits

- Highly efficient, over 70% lower operating costs and heat input into the fluid
- Modular design, 60 PSI/stage
- Active thrust balancing system for extended bearing life
- High efficiency hydraulics with extremely low NPSHR inducer
- Light weight and compact
- Available in sump and in-tank designs
- Special design VFD drive provides operation point control over the entire pump operating range
- Features a quick electrical disconnect for ease of maintenance
- Permanent magnet motor
- All parts from wrought aluminum precision machined
- Vacuum jacketed sump
- Heavy duty ceramic bearings

#### Applications

- Bunkering barge-to-ship
- Low pressure marine fuel systems
- Send-out pump
- Liquid storage transfer
- Bunkering operations ship-to-ship
- Pipeline feed
- FSRU loading/off-loading
- Railcar tender car loading and unloading

#### Liquids Pumped

- Nitrogen
- Argon
- Ethylene
- Ethane
- Methane (LNG)

#### Propane

#### **Complete Pumping System**

- High-efficiency submerged pump
- Removeable in-tank with foot valve
- Custom made VFD drive factory string tested
- Dual electrical feed thru hermetically sealed up to 500A

- Differential pressure gauge
- Loss of prime detector (cavitation protection)
- Safety relief valve
- Dual conduit box per NFPA standards for LNG services
- Complete removal systems
- Long term storage container



# ACD Reciprocating Pumps



### Model ACPD. Cylinder Filling Pump.



#### Specifications: standard ACPD systems\*

Dorro v Chroko	in	1.0 x 0.79	1.0 x 1.26	1.2 x 0.79	1.2 x 1.26
Bore x Stroke	mm	25 x 20	25 x 32	30 x 20	30 x 32
Eleve Dete	gpm	0.23 – 1.20	0.37 – 1.92	0.34 – 1.73	0.54 – 2.76
Flow Rate	lpm	0.88 - 4.56	1.41 – 7.27	1.27 – 6.56	2.03 - 10.46
Maximum Pump	hp	15	15	15	15
Design Rating	kw	11	11	11	11
NPSPR	psi	2	2	2	2
	bar	0.1	0.1	0.1	0.1
Maximum Suction	psi	300	300	300	300
Pressure	bar	20.7	20.7	20.7	20.7
Maximum Working Pressure	psi	6000	6000	4000	4000
	bar	414	414	276	276
Speed Range	rpm	100 – 515	100 – 515	100 – 515	100 – 515

\* Contact ACD engineering for specific performance ratings.

#### Features & Benefits

- Vacuum jacketed cold end helps minimize heat leak and reduce product loss
- Stainless steel drive housing for extended pump life
- Split drive end housing for easy maintenance access
- Monel suction strainer for oxygen compatibility
- Grease lubricated, sealed-for-life bearings for extended operation
- Extended stem vacuum port with positive seal for improved vacuum integrity
- Intermediate purge connection allows for extended packing life
- Positive locking drive coupling for improved safety operation

#### Applications

- Cylinder filling
- Test stand

#### **Liquids Pumped**

- Nitrogen
- Oxygen
- Argon
- Hydrogen
- Methane (LNG)

#### Typical Scope of Supply (SKID)

- Vacuum jacketed cold end with grease lubricated drive assembly
- Electric motor with belt drive and guard
- Stainless steel drive housing
- Hot dipped galvanized steel skid
- Over pressure switch and gauge
- PLC control panel (NEMA 4) with combination motor starter and running time meter (shipped loose)
- Discharge line with high pressure relief valve and surge chamber
- Low pressure vent valve
- Monel suction strainer

## 3-GUPD Series. High Flow/High Pressure Pump.



Available with SG cold end, 1.625" bore

#### **Features & Benefits**

- Rugged, heavy duty construction allows for high reliability in oil well service operations
- Main shaft is pressure lubricated minimizing wear and tear on bearings/ crosshead piston while keeping all components cool
- Interchangeable with SG cold ends expanding capabilities. All cold ends have minimal material for quick cooldown and minimal wear and tear at start-up
- Multiple cold end sizes and drive end strokes allow for wide range of flows and pressures providing flexibility to end users and applications

#### Applications

- Oil well service
- High pressure pumping systems
- Mobile pumping applications
- N<sub>2</sub> purging

#### **Liquids Pumped**

- Nitrogen
- Methane (LNG)
- Ethylene

#### **Specifications**

Para v Straka	in	1.25 x 1.3	1.625 x 1.3	2.00 x 1.3
		1.25 x 1.5	1.625 x 1.5	2.00 x 1.5
Eleve Data	gpm	1.75 – 18.3	0.99 – 32.0	4.50 – 48.8
Flow Rate	lpm	6.62 - 69.5	3.76 - 121.0	17.0 – 185.0
Pump Design	hp	205	205	205
Rating	kw	153	153	153
Maximum	psi	17,000	10,000	6,500
Discharge Pressure	bar	1,172	690	448
NEODE	psi	60	60	60
NPSPR	bar	4.1	4.1	4.1
Speed Range	rpm	100 – 940	100 - 940	100 - 940

Consult ACD engineering for actual performance ratings.

#### **Typical Scope of Supply**

- Foot-mount pump shown (cold ends & drive end)
- Digital tach adapter
- LN<sub>2</sub> tested

- SG, non-vacuum jacketed cold ends, p/n 60740-1
- Mechanical tach adapter
- Boost pump

### MSP-3SL. High Flow/High Pressure Pump.



Model DVX-150

#### **Specifications**

Flow Rate	1 – 31 m³/h
Pressure	200 – 600 bar
Suction Pressure Req'd	4 bar (above saturation pressure)
Power Required	50 – 300 kW

#### Model

Model	Dimensions (LxWxH)	Weight
DNS-150	220mm x 100mm x 1900mm	7,000 kg
DNS-200	220mm x 110mm x 1900mm	12,700 kg
DNX-100	6700mm x 2700mm x 1800mm	14,000 kg
DNX-200	5500mm x 2700mm x 2100mm	10,000 kg
DVX-150	6600mm x 2700mm x 2500mm	15,000 kg
SNS-150	3400mm x 2700mm x 1900mm	7,500 kg

#### **High Pressure Fuel Pump System**

Over 50 LNG fueled ships operate with ACD pumps, more than any other brand

- Class approvals ABS, DNV, LR
- Designed for cargo & containerships
- Meets all ME-GI requirements
- Actual operating experience

### ACD's Class Approvals







DNV.GL

# TOTE, Marlin Class Containership. ACD's DNX-200 used (USCG compliant)



## P2K Model. The Safest Design In The Industry.



Specifications: standard P2K pumping systems*					
	in	1.25, 1.50 x 1.50	1.75 x 1.50	2.00 x 1.50	
Bore x Stroke	mm	32, 38 x 38	44.5 x 38	50.8 x 38	
	gpm	1.13 – 3.10	2.20 - 4.20	2.87-5.53	
Flow Rate	lpm	4.27 - 11.73	8.32 - 15.89	10.90 - 20.93	
Pump Design Rating	hp	7.5 – 20	10 – 20	15 – 20	
	kw	5.6 – 15	7.5 – 15	11.2 – 15	
Maximum Discharge Pressure	psi	6,000	4,500	3,500	
	bar	414	310	241	
NEODE	psi	2	2	2	
NPSPR	bar	0.14	0.14	0.14	
Maximum	psi	300	300	300	
Suction Pressure	bar	20.7	20.7	20.7	

\* Contact ACD for additional P2K pump ratings.

#### Features & Benefits

- Vertical pump design eliminates gravitational loading on the piston, extending sealing ring life and providing smoother suction valve operation
- Vertical installation offers less vibration, reduced noise, and a compact system footprint
- V-band clamp secures the sump to the intermediate, allowing quick and easy access to the cold end assembly
- External re-lubrication nipples for roller bearings and crosshead provide extended service life
- Replaceable crosshead wearband eliminates crosshead piston wear and reduces maintenance costs

- Packing rings at top of pushrod are retained in cartridges for easy replacement (no removal of sump and cold end required)
- Motor positioned on the backside of the pumping skid eliminates possible fire, explosion, or hazard in the event of a liquid oxygen leak
- Vertical cold end is submerged inside a vacuum-jacketed liquid sump, minimizing heat leak and increasing system efficiency (particularly in poor suction conditions)
- Pump assembly and spare parts are interchangeable with the PD3000 pump
- Easy cold end maintenance by swiveling the pump and drive end 45°

#### Applications

- Heavy duty cylinder filling
- Medium duty storage filling
- Unattended, automatic storage filling

### Liquids Pumped

- N<sub>2</sub>, O<sub>2</sub>, Ar, CO<sub>2</sub>
- Methane (LNG)
- Ethylene

#### Typical Scope of Supply

- Grease-lubricated drive assembly and vacuum-jacketed cold end
- Electric motor with belt drive and guard
- Hot-dipped galvanized steel skid frame
- Over pressure switch gauge (shipped loose)
- Control panel with combination motor starter and running time meter (shipped loose), relay logic
- Vent line with manual valve and low pressure relief valve
- Monel suction strainer
- High pressure relief valve with discharge line and surge chamber

## P1100 Series. Cylinder Filling Pump.



#### Specifications

	gpm	5.8	
Flow Rate	lpm	21.9	
	lb/min	50	
	psi -	Min. 200	
Quelies December		Max. 450	
Suction Pressure	bar	Min. 13.7	
		Max. 31	
Pump Design Rating	hp	7.5	
@1000 psi (69 bar)	kw	5.6	
Maximum	psi	1,200	
Working Pressure	bar	82.7	
Skid SettingsHigh pressure relief valve setting 1,200 psi (82.7 bar)Burst disc pressure bypass relief valve setting1,000 psi (69 bar)Burst disc pressure point 2000 psi (138 bar)		ure relief valve setting 1,200 psi (82.7 bar) ure bypass relief valve setting1,000 psi (69 bar) pressure point 2000 psi (138 bar)	

60 HZ performance

#### Features & Benefits

- Vertically positioned floating piston means longer life
- Simple cold end design assembly, easy maintenance
- Large piston diameter and longer pump stroke mean slower speeds and smooth operation
- Pump packing is easily adjusted through a large access port, which allows for extended packing life
- Splash oil lubricated drive provides extended pump life and minimizes maintenance requirements

#### Applications

- Carbon dioxide cylinder filling
- Nitrous oxide cylinder filling

#### Liquids Pumped

- Carbon dioxide
- Nitrous oxide

#### Typical Scope of Supply (SKID)

- Cold end and drive assembly, TEFC electric motor
- Galvanized steel base plate with drive and guard
- NEMA 1 pushbutton starter
- Surge chamber
- Relief valve and burst disc
- Pressure gauge and snubber
- Safety bypass relief valve arrangement automatically returns liquid to tank at 1000 psi (69 bar)
- Oil lubricated drive end (oil shipped loose)

#### FOR PUMPS INTENDED TO BE USED IN NITROUS OXIDE SERVICE:

Liquid Nitrous Oxide is a potentially dangerous fluid and must be handled with extreme care. See Compressed Gas Association standard CGA G-8.3-2016 for further information. Under certain combinations of temperature and pressure Nitrous Oxide can explosively decompose with serious consequences. Nitrous Oxide is an oxidizer that actively supports combustion. Nitrous Oxide handling equipment must be cleaned for Oxygen service. Design and construction of storage and piping systems for pumping liquid Nitrous Oxide must assure material compatibility and be such as to prevent loss of prime or "dry running" of pumps. Nitrous Oxide is an active solvent for many materials and material compatibility with Nitrous Oxide must be confirmed before their use. For additional historical information relating to hazards associated with Nitrous Oxide decomposition refer to Chemical Safety Board report number 2016-04-I-FL Dated February 2017.

### Model RPSA. Cylinder Filling Pump.



#### Specifications: standard RPSA models

	in	1.57, 1.77 x .79	1.57, 1.77 x 1.26
Bore x Stroke	mm	40, 45 x 20	40, 45 x 32
	gpm	2.2 - 3.6	22.8 - 4.5
Maximum Flow Rate	lpm	8.5 – 13.5	10.5 – 17
Duran Danian Datian	hp	10	15
Pump Design Rating	kw	7.5	11
Maximum	psi	1,740	1,740
Discharge Pressure	bar	120	120
Maximum	psi	435	435
Suction Pressure	bar	30	30

60 HZ performance

#### Features & Benefits

- Tungsten carbide coated piston helps increase the life of the seals
- Simple cold end design assembly for easy maintenance
- Heavy duty grease lubricated drive for longer life and less maintenance (regreasing not necessary)
- Pump packing is adjusted through a large access port for easy adjustments and extended packing life

#### Applications

- Carbon dioxide cylinder filling
- Nitrous oxide cylinder filling

#### **Liquids Pumped**

- Carbon dioxide
- Nitrous oxide

#### **Typical Scope of Supply**

- Cold end, grease lubricated drive assembly, and electric motor
- Galvanized steel base plate with belt guard
- Surge chamber and relief valve

#### FOR PUMPS INTENDED TO BE USED IN NITROUS OXIDE SERVICE:

Liquid Nitrous Oxide is a potentially dangerous fluid and must be handled with extreme care. See Compressed Gas Association standard CGA G-8.3-2016 for further information. Under certain combinations of temperature and pressure Nitrous Oxide can explosively decompose with serious consequences. Nitrous Oxide is an oxidizer that actively supports combustion. Nitrous Oxide handling equipment must be cleaned for Oxygen service. Design and construction of storage and piping systems for pumping liquid Nitrous Oxide must assure material compatibility and be such as to prevent loss of prime or "dry running" of pumps. Nitrous Oxide is an active solvent for many materials and material compatibility with Nitrous Oxide must be confirmed before their use. For additional historical information relating to hazards associated with Nitrous Oxide decomposition refer to Chemical Safety Board report number 2016-04-I-FL Dated February 2017.

### SGV Series. Storage Filling Pump.



Specifications				
	in	1.25 x 1.38	1.625 x 1.38	1.97 x 1.38
Bore x Stroke	mm	32 x 35	41 x 35	50 x 35
	gpm	0.94 – 15.3	1.6 – 25.9	2.35 – 38.1
Flow Rate	lpm	3.56 – 57.9	6.1 – 98.0	8.9 - 144.2
	LH <sub>2</sub> gpm	0.90 – 10.8	1.52 – 18.3	2.25 - 26.9
Pump Design Rating	hp	15 – 200	15 – 200	15 – 200
	kw	11 – 150	11 – 150	11 – 150
Maximum	psi	10,000	6,000	6,000
Discharge Pressure	bar	690	420	420
NPSPR	psi	10	5	5
	bar	0.70	0.35	0.35

60 HZ performance

1-cylinder SGV

#### Features & Benefits

- Modular, compact displacement pumps available in 1, 2, or 3 cylinder configurations provide a wide range of flows
- Vacuum jacketed cold end for minimal cooldown losses and economical operation, ideal for liquid hydrogen
- Pressurized oil lubricated drive with integral oil pump and reservoir, allows higher bearing loads/prevent oil leakage
- Belt driven by electric drive motors allows for extended pump duty
- Improved cold end assembly design extends seal life

#### Applications

- Specially designed for storage filling
- Special medium to heavy duty applications
- LNG, LN<sub>2</sub>, LH<sub>2</sub> process

#### **Liquids Pumped**

- Nitrogen
- Oxygen
- Argon
- Hydrogen
- Methane (LNG)

#### **Typical Scope of Supply**

- Vacuum jacketed cold end with pressure oil lubricated drive end
- Positive locking coupling
- Standard suction adapter with Monel strainer
- Distance piece with purge ports
- Hot dipped galvanized steel skid
- TEFC motor
- High pressure relief valve with discharge line and surge chamber
- Drip pan kit for LH<sub>2</sub> only
- Suction/vapor return manifold for multiple cylinders

#### FOR PUMPS INTENDED TO BE USED IN NITROUS OXIDE SERVICE:

Liquid Nitrous Oxide is a potentially dangerous fluid and must be handled with extreme care. See Compressed Gas Association standard CGA G-8.3-2016 for further information. Under certain combinations of temperature and pressure Nitrous Oxide can explosively decompose with serious consequences. Nitrous Oxide is an oxidizer that actively supports combustion. Nitrous Oxide handling equipment must be cleaned for Oxygen service. Design and construction of storage and piping systems for pumping liquid Nitrous Oxide must assure material compatibility and be such as to prevent loss of prime or "dry running" of pumps. Nitrous Oxide is an active solvent for many materials and material compatibility with Nitrous Oxide must be confirmed before their use. For additional historical information relating to hazards associated with Nitrous Oxide decomposition refer to Chemical Safety Board report number 2016-04-I-FL Dated February 2017.

# SLS. High Flow/Pressure Nitrogen Pumps.



5-SLS



#### 3-SLS

#### Features & Benefits

- Improved drive end design allows for longer life and cooler temperatures during operation
- Multiple configurations enable adaptability and conformity to mobile and/or stationary applications using a standard base model
- Better than 30-to-one turndown ratios allows for a wide range of operating parameters, including low enough flows to meet coil-tubing applications
- Non-Key Polygon Design reduces drive end failure risk due to shaft key

#### **SLS Warm Ends**

#### 3-SLS

- Counter balance optional
- Left or right hand
- Diverted cooling

#### 3-SLSGRO

- Counter balance optional
- Gear reduction
- External oil pump
- Diverted cooling





#### 5-SLSGRO

- Counter balance optional
- Gear reduction
- External oil pump
- Gear reduction
- Digitial tachometer



#### **Nitrogen Purging**

Nitrogen purging using ACD pumps is a technique used to replace hydrocarbon vapors, flammable and toxic gases or air with an environmentally safe and inert dry atmosphere. The two most common methods of purging are displacement and dilution. The geometry of the process system determines which method is used. For simple systems, displacement purging is usually more effective in terms.

#### High Temperature Nitrogen

Delicate operations such as furnace bake-outs, catalyst regeneration and hydrocarbon and solvent stripping have been safely performed using high temperature inert.

### Service and Support.



#### Installation, Commissioning and Service Support

- Class approvals ABS, DNV, LR
- Designed for cargo & containerships
- Meets all ME-GI requirements
- Actual operating experience

#### Annual Service Package - Basic

- 24/7 technical support via phone and/or email with dedicated contact information
- Standard exchange items:

Item/Assembly	Exchange Interval	Standard Cost (USD)	Additional Billing Apply**
MSP-SL Cold ends	3,000 – 5,000 hrs	Contact ACD*	Yes
Lube Oil Filters	Annual	Contact ACD*	No
MSP-34.2 Assembly	20,000 hours	Contact ACD*	No

\* Wear parts and labor included

- \*\* May apply based on wear of non-standard exchange parts
- Training will be provided to ship technicians once per year for:

- 3 training days

- Installation and removal of cold ends, filters and submerged pumps
- Normal operation of pump systems and trouble shoopting techniques
- 48 hour shipping of parts/cold ends from one of ACD's global service locations
- Non-Emergency Call outs

**Global Network** 

ACD ACD – Atlanta ACD – California ACD – Dubai ACD – Houston ACD – India ACD – Pittsburgh ACD Europe (ACD Cryo) Cosmodyne CryoCanada - Red Deer CryoCanada - Toronto Cryogenic Industries – China Cryogenic Industries - Korea Cryogenic Industries – Malaysia Cryoquip Cryoquip - Australia Cryoquip - China Cryoquip - India Cryoquip - Malaysia Cryoquip – UK

Rhine Engineering



# Nikkiso Cryo Centrifugal Pumps

### Submerged Motor Cryogenic Pumps.

#### Unmatched Reliability, Quality and Safety

As part of the Nikkiso Company global organization, our "original technologies" provide our customers with the confidence in knowing they are receiving the latest technology and the highest standards of engineering available.

Located in North Las Vegas, Nevada, in the USA, Nikkiso Cryo offers a full range of submerged pumps for LNG, LPG, LEG,  $LN_2$ , liquid propylene and many other liquefied gases.

With design, production and test facilities in both the USA and Japan, sales offices in Las Vegas, Houston, London and Tokyo, Nikkiso Cryo offers prompt and full support for all of our customers worldwide.







### Removable In-Tank Pump.



#### **Features & Benefits**

Removable, or in-tank pumps offer the advantage of overhead removal and installation without taking the tank out of service. The pump operates at the bottom of a purpose-built pump column through which it is installed and removed. The column provides the fluid discharge from the pump to the top of the tank and contains the lifting cables as well as the power cables. Our ZEN (Zero Enabled NPSH) inducer was specially developed to allow the pumps to reduce liquid levels to extremely low levels.

#### Applications

- Liquefaction & FPSO
- Loading Pump
- Recirculating Pump
- Reflux Pump

**Regasification & FSRU** 

- Primary Pump
- Emergency Pump (FSRU)



#### Liquids Pumped

- = LNG
- = LPG
- = LEG
- LN2
- Liquid Propylene
- And more

#### Scope of Supply

- Pump
- Foot Valve
- Lifting & Electrical Cables
- Head Plate
- Feed Through, Junction Box
- Vibration Monitoring System

### Suction Vessel Mounted Pump.



#### Features & Benefits

This design is provided with the pump and suction vessel which become an integral part of the piping system with external suction and discharge connections. The pump is mounted to the top or headplate of the vessel such that the pump, motor and fluid product are totally contained within the pressure vessel. Shaft seals are eliminated. The pump inlet is below the suction vessel inlet which allows the source tank liquid levels to be lowered to a minimum.

#### Applications

Liquefaction & FPSO

- Transfer Pump
- Booster Pump

Regasification & FSRU

- Send Out Pump
- Line Packing Pump

#### Cogeneration

- Turbine Feed Pump
- Vehicle Fueling
- Fueling pump



#### **Liquids Pumped**

- LNG
- = LPG
- = LEG
- = LN<sub>2</sub>
- Liquid Propylene
- And more

#### Scope of Supply

- Pump
- Vessel & Head Plate
- Feed Through, Junction Box
- Vibration Monitoring System

### Fixed In-Tank Pump.





#### **Features & Benefits**

This pump type is mounted directly to supports in the bottom of a storage tank and connected to a discharge pipe which extends to the top of the tank and out to the discharge piping. This simple and low-cost design is used in liquefied gas carriers and in any other application where removing the liquid from the tank for maintenance is a normal or required process and can be accomplished without excessive costs to the tank or system.

#### Applications

Liquefaction & FPSO

Spray Unloading Pump (FPSO)

Regasification & FSRU

- Unloading pump (FSRU)
- Primary Pump (FSRU)

#### Liquids Pumped

- LNG
- = LPG
- = LEG
- = LN<sub>2</sub>
- Liquid Propylene
- And more

#### Scope of Supply

- Pump
- Feed Through, Junction Box
- Vibration Monitoring System

### Quality and Safety.

#### Strive to Achieve the Highest Level of Quality Possible

Nikkiso Cryo is committed to continuous improvement of our products and services and to meet or exceed the requirements of our customers. It is through this commitment that Nikkiso Cryo has developed a reputation as a loyal and trustworthy supplier producing a quality product known for its high reliability.

#### Certified to ISO 9001

Our internal corrective action system helps assure that any lessons learned are immediately corrected not only for the current project, but in all of our internal systems to ensure all future processes and designs are as trouble-free as possible. We believe that quality is a continuous process that requires us to never stop trying to improve.

#### Submerged Motor Pump Design Provided High Level of Safety

With the motor submerged in the pumped fluid, where no oxygen is present during operation, the submerged motor pump design provided by Nikkiso Cryo provides the highest level of safety.

The design uses a common shaft between the motor and the pump section that removes the need for a rotating seal, which eliminates the possibility of hazardous gases leaking into the atmosphere.

In addition, the terminal header, which provides connections for the power cables to penetrate through a static seal from the pumped fluid to the external conduit section, is certified for use in hazardous areas for the safest installation possible.





### State-of-the-Art Inducers.

Specially developed with high speed inducer technology from the aerospace industry, the inducers allow the pumps to reduce liquid levels to extremely low levels.

For pumps operating in liquefied gases, where pressures and temperatures of the pumped fluid are sometimes near their boiling point, the use of inducers in the pump inlet is necessary to ensure adequate NPSHR or Net Positive Suction Head Required, is supplied to the main centrifugal impellers. Nikkiso Cryo uses low solidity fan-type inducers as well as high solidity spiral-type inducers depending on the application. These inducers with high suction specific speeds, provide excellent low suction pressure performance over a wide flow range.

For applications which require tank levels to be minimized as much as possible, Nikkiso Cryo has developed a spiral inducer with very high suction specific speeds. Our ZEN—Zero Enabled NPSH—Inducer was specially developed based on high speed inducer technology from the aerospace industry to allow the pumps to reduce liquid levels to extremely low levels, which maximizes usable tank volume.



#### ◆ NPSH ■ Inducer Head --- Rated Capacity --- 110% Capacity --- 80% Capacity





--- Heat --- Power --- Efficiency

### Innovative Systems.

#### **Vibration Systems**

As a result of our research and development team and through our Aftermarket Service organization, operating personnel can be trained to interpret data acquired from the condition monitoring system. Nikkiso Cryo's research and extensive experience allows for correlation of monitoring specific vibration modes with specific operating and wear conditions. Condition monitoring and trend analysis has the potential to provide more complete diagnostic information on an operating pump than physical inspection of the disassembled pump. This facilitates optimum timing of maintenance considering factors of reliability, operation and costs. Condition monitoring permits scheduling maintenance only when essential and indicates the need for immediate maintenance to prevent outages and loss of production.

Monitoring Pump vibration is an excellent means to determine pump condition; however, this is particularly challenging for submerged motor cryogenic pumps which have no exposed surfaces or shaft for making direct measurements from the outside of the containment vessel. Nikkiso Cryo can supply piezoelectric accelerometers designed for use directly submerged in the pumped liquid, mounted on the pump housings, and can also locate accelerometers on the outside of suction vessel mounted pumps to provide monitoring of pump vibration. These sensors can measure pump acceleration vibration directly and, with signal conditioning, provide velocity and displacement amplitude data. The condition of internal parts and the extent of wear can be determined by trend monitoring and frequency analysis.

#### **Electrical Systems**

As a supplier of submerged motor pumps operating in hazardous environments, Nikkiso Cryo has extensive experience in the selection and design of the proper electrical components to ensure a safe and certified system. These systems can be purged with nitrogen gas to remove moisture from the boundary section between cold and warm, and the purge gas pressure can also be monitored to determine if leakage exists. Electrical systems are supplied to meet plant specifications as well as US, European and any other international codes as required. The systems supplied by Nikkiso Cryo are of the highest quality and are fully tested prior to shipment to ensure the highest level of reliability.



### Testing and Reliability.

Nikkiso Cryo offers performance testing at full speed, power and flow using LNG, LPG or LN<sub>2</sub> at our facility in Las Vegas, Nevada, or using LN<sub>2</sub> at our facility in Tokyo, Japan. The pumps undergo rigorous testing throughout the flow range, with flow, pressure, motor power and many other measurements taken using calibrated systems to ensure compliance with project requirements.

NPSH as well as complete pumpdown can be measured as well as axial shaft position to ensure the thrust balance system is performing as designed.

Testing is performed to very strict Nikkiso Cryo standards in addition to API, ASME and other international standards and project requirements. Factory performance testing ensures that each and every pump meets exacting standards and provides trouble-free performance once it has been installed and is operating at the customer's site.

#### Reliability - Second to None

As a result of unique design features that control bearing loads and our multiple bearing technology, Nikkiso Cryo pumps provide unparalleled reliability. In many cases, mean time between overhauls **exceeds 20,000 hours**, with some pumps recording **more than 40,000 hours**.



### Global Service and Innovation.

#### Nikkiso Cryo Global Services

- Installation, commissioning and repair
- Technical training
- Spare parts management
- Engineering, failure analysis

With field service staff located in the USA and Japan, and with the support of our factory engineering staff, Nikkiso Cryo is focused on responding to all service needs with a sense of urgency and commitment. We recognize that downtime at our customers' sites results in losses of productivity and revenue, and we strive to provide the most prompt and efficient service possible.

Our experienced Aftermarket Services Group can provide all of your service needs, with supervisory services from initial installation, commissioning, maintenance, repairs and training, to assist with spare parts management and operational procedure review.



#### Nikkiso Cryo Innovation

**Global Network** 

- Exclusive horizontal assembly process for large, multistage high pressure pumps, reducing the need for specialized pump maintenance facilities at the job site.
- Multiple bearing technology for multistage high pressure pumps to ensure rotor dynamic stability and unsurpassed reliability.
- Pioneer of first high pressure vaporizer feed pumps for FSRU's with more marine and offshore high pressure pumps built than any other competitor by far.
- Specially developed ZEN<sup>™</sup> spiral inducers to provide extremely low pumpdown characteristics.

Ongoing service from monitoringpump operating to field service and maintenance.

Nikkiso cryo now services and supplies parts for:



Algeria	Germany	Philippines	Thailand
Australia	India	Portugal	U.A.E.
Austria	Indonesia	Qatar	United Kingdom
Belgium	Japan	Russia	United States
Brunei	Kuwait	S. Korea	Vietnam
China	Malaysia	Singapore	
Egypt	Mexico	Spain	
France	Netherlands	Taiwan	



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