CEBA Tank pump for auto gas stations

Multistage **side channel pumps with NPSH-impeller and** with magnetic drive

Installation and Operating Instructions (Translation of the original instructions)

Attention: This pump or this pump unit, respectively may be mounted and put into operation by qualified technical personnel only and these operating instructions and the effective regulations have strictly to be observed. If you do not pay attention to these operating instructions,

- **danger** may be created for you and your colleagues,
- the pump or the pump unit may be **damaged**,
- **the manufacturer is not liable** for damages resulting from this non observance!

Please be aware of your responsibility for your fellow men when working at the pump or the pump set!

Safety instructions marked with ⟨Ex⟩ **have to be considered in particular when operating this pump in potentially explosive atmospheres!**

Document - No. : **CEB00E**	**Sterling Fluid Systems (France)**
Revision : **03**	1-3 Avenue Georges Politzer-B.P 41-78193 Trappes France
Date : **06/04/2010**	Telephone: +33 (0)1 34 82 39 00 Fax: +33 (0)1 34 82 39 61
SAP Doc. : **26598/TD/EN/03**	**Member of the Sterling Fluid Systems Group**

1 Safety

1.1 Safety instructions

This manual gives basic instructions which must be observed during installation, operation and maintenance of the pump.

It is therefore imperative that this manual be read by the fitter and the responsible personnel or operator prior to assembly and start up. It must always be kept available at the installation site.

Within this manual, safety instructions are marked with safety symbols.

Safety symbol to ISO 3864-B.3.1

This general hazard symbol highlights information non-compliance with which could cause a risk to personal safety.

Safety symbol to ISO 3864-B.3.6

This symbol refers to electrical safety.

This word gives warning of a hazard to the machine.

CAUTION

Safety instructions that have to be considered when operating this pump in potentially explosive atmospheres are marked with the word:

Signs affixed to the machine, e.g.

- arrow indicating the direction of rotation
- symbols indicating fluid connections

must be observed and kept legible.

1.2 Qualification and training of operating personnel

The personnel responsible for operation, maintenance, inspection and assembly must be adequately qualified.
The responsibilities of the operating personnel must be exactly defined by the plant operator.

If the staff do not have the necessary knowledge, they must be trained and instructed, which may be performed by the machine manufacturer or the supplier on behalf of the plant operator, if required.

Moreover, the plant operator is to make sure that the contents of this manual are fully understood by the operating personnel.

1.3 Hazards in the event of non-compliance with the safety instructions

Non-compliance with the safety instructions may cause a risk to the personnel as well as to the environment and the machine and may result in a loss of any right to claim damages.

For example, non-compliance may involve the following hazards:

- failure of important functions of the equipment
- failure of specified maintenance and repair procedures
- electrical, mechanical and chemical hazards affecting personal safety
- release of environmentally damaging substances

1.4 Safety at work

When operating the pump, the safety instructions contained in this manual, the relevant national accident prevention and explosion protection regulations and any other service and safety instructions issued by the plant operator must be observed.

1.5 Safety instructions relevant to operation

- If hot or cold machine components involve hazards, the customer must ensure these components are guarded against accidental contact.

- Contact guards for moving parts (e.g. coupling) must not be removed from the machine while in operation.
- Any leakage of hazardous (e.g. explosive, toxic, hot) fluids (e.g. from the shaft seal) must be drained away so as to prevent any risk to personal safety or the environment. Statutory regulations must be complied with.
- Hazards resulting from electricity must be prevented. Local regulations must be complied with.

1.6 Safety instructions relating to maintenance, inspection and assembly work

It shall be the plant operator's responsibility to ensure that all maintenance, inspection and assembly work is performed by authorised and qualified personnel who have adequately familiarised themselves with the subject matter by studying this manual in detail.

Any assembly or maintenance work on the machine shall only be performed when it is at a standstill. The procedure for stopping the machine described in this manual must be followed.

Pumps which handle hazardous fluids must be decontaminated.

On completion of work all safety and protective facilities must be re-installed and made operative again.

Prior to restarting the machine, the instructions listed under sub-section "Checks before first start-up" must be observed.

1.7 Safety instructions for the use in potentially explosive atmospheres

In this paragraph information are given for an operation in areas with explosion hazard.

1.7.1 Arrangement of the units

If the pump is completed with other mechanical or electrical components to one unit, the complete unit may be considered only as device category according to the directive 94/9 EC which is fulfilled by all used components.

The operator has always to pay attention to the conformity of all used components of the pump unit with the directive 94/9 EC.

1.7.2 Execution of coupling guards for shaft couplings

Coupling guards which shall be used in areas with explosion hazard have to fulfil the following criteria:

- do not use sparking material e.g. brass or
- steel plate constructions executed this way that with faults to be foreseen (e.g. deformation by stepping on the coupling guard) a contact between the rotating parts and the coupling guard is excluded.

1.7.3 Priming of the pump

For the first starting after installation the CEB pump must be deaerated. Side channel pumps can convey large amounts of gas. A liquid gas mixture can therefore be expected to be present in the pump, especially during the start-up phase.
In order to prevent such a mixture from exploding as a result of high temperatures in the area of the plain bearings and/or the electrically conductive can, the **suction phase** for inflammable liquids must **not exceed 90 seconds**.
During continuous operation, the pump can be expected to contain sufficient liquid at all times so that the lubrication of the plain bearings and cooling of the can are ensured.
Due to the wetted surfaces of the components exposed to the liquid, no sparking resulting in an explosion inside the pump should occur, even if the side channel impellers rub on the stage casings.

1.7.4 Avoidance of exterior impact effect

The operator has to ensure that with an operation of the machine in areas with explosion hazard no exterior impact effect to the machine casing may arise.

1.8 Unauthorised alterations and production of spare parts

Any modification to the machine is permissible only within the limits as documented by Sterling SIHI or after consultation with Sterling SIHI.

Using genuine spare parts and accessories authorised by the manufacturer is in the interest of safety. Use of other parts may exempt the manufacturer from any liability.

1.9 Unauthorised use

The reliability of the pump delivered will only be guaranteed if it is used in accordance with this manual.

2 Intended application

Tank pump for auto gas stations

2.1 General

- This pump is suitable for liquids containing no regular solids or ferromagnetic substances.
- The liquids to be handled must not tend to evaporate, crystallise out, polymerise or freeze under the prevailing pressure and temperature conditions.
- We assume warranty responsibility under our conditions of sale.
- The pump must not be operated beyond the operating limits according to these operating instructions and the characteristic curve.
- If the pump is to be used for data other than those stated on the enquiry (for which the pump set has been designed), please check the suitability on a case-by-case basis. It is, in particular, the magnetic-drive coupling design and the motor selection which depend on the delivery data, the temperature and the physical properties of the liquid handled. If there is any doubt, please contact Sterling SIHI.
- According to 94/4 EG the pump belongs to equipment group II, category 2. The nameplate designation is **Ɛx II 2G T1-T5**.

2.2 Wrong use

- The motor torque must not exceed the rated load torque of the magnetic-drive coupling in order to avoid excessive temperatures and destruction of the coupling.
- If hot fluids are pumped, the pump surface temperature will increase considerably and it would be dangerous to touch it. Section 9 includes information about the surface temperature.
- The pump shaft is carried in ceramic plain bearings. Avoid direct impact or shock or thermal shock. The temperature of the liquid handled inside the pump should be changed at a velocity of max. 100K/min. Use extreme care when filling the pump with a hot fluid.

CAUTION

2.3 Accessories

Accessories installed by the customer must not impair pump function or safety.
Sterling SIHI recommends that particular quanties be measured as part of pump monitoring (see Section 3). For information on suitable devices, contact Sterling SIHI.

2.4 Pump version

The nameplate specifies the pump version supplied (see table under 2.6).

2.5 Design and operating principle

CEB-pumps are vertical side channel tank pumps handling gas along with. As pumps with segmental type construction with open vane wheels and pre-arranged centrifugal stage, they are designed for reaching favourable NPSH-values.
The CEB has a special NPSH-impeller, which makes only a low liquid level above the pump inlet necessary.
The used drive motor is an asynchronous standard motor which is mounted to the pump above a stool.
The sealing against atmosphere is made by an isolation shroud. The driving torque of the motor is transmitted to the pump shaft by a magnetic coupling. The pump shaft is run in two sleeve bearings lubricated by the medium. The outer part of the magnetic coupling (magnetic bell) is placed on the shaft end of the motor, the interior magnet is on the pump shaft. The isolation shroud is in the gap between magnetic bell and interior magnet.

2.6 Product identification

Pos.	Characteristic	Code	Explanation
1-3	**Type**	CEB:	Multi stage side channel pump in close coupled design with NPSH-impeller with magnetic coupling
4	**Construction**	A: Y:	See technical description Special design
5-6	**Size**	20:	nominal width of the nozzles: DN 20
7-8	**Number of stages**	01 - 08	1 - 8 stages
9-10	**Pump length**	A7	Tank internal pump length A = 1m, 7 =7 dm
11	**Hydraulic**	A	First hydraulic, flanges acc. to PN 40
12	**Bearings**	F	close coupled pump 2 sleeve bearings, lubricated by the pumping medium
13 - 14	**Shaft sealing**	1A, 2A, 3A, 4A: 2B, 3B:	Coupling system 1/2/3/4, metallic isolation shroud; Coupling system 2/3, ceramic isolation shroud
15	**Torque**	A - Z:	describes the nominal torque of the magnetic coupling, see table in chapter 9
16 - 17	**Material** For detailed material description see table in chapter 9	1A: 1B: 1F: 4B: 4F	SG-iron, vane wheel impeller: brass SG-iron, vane wheel impeller: chrome steel SG-iron, vane wheel impeller: PAEK Stainless steel, vane wheel impeller: stainless steel Stainless steel, vane wheel impeller: PAEK
18	**Casing sealing and flange design**	4: A: E: F:	Soft PTFE between the stages, PTFE-O-ring at the isolation shroud, flanges acc. to DIN 2501, PN40 As 4, but flanges with groove acc. to DIN 2512, form N As 4, but flanges drilled acc. to ANSI 150 RF As 4, but flanges drilled acc. to ANSI 300 RF
19 - 20	**Motor size**	A* - Z*	Named in acknowledgement of order

3 Planning of the installation

Caution 

Please also refer to **chapter 9 – Installation Instructions SIHI LPG pumps.**

3.1 Pipework

CAUTION 

- Please observe the flow direction arrows on the pump nozzles.
- Nominal piping diameters must not be smaller than the nominal pump nozzle diameters.
- Clean the pipelines before pump installation.
- The pipework must be independently supported and positioned to avoid distortions and breakage of pump parts. Ensure that the permissible nozzle forces and moments (see annex) are not exceeded.
- Install the pipework such that thermal expansion does not lead to additional forces acting on the pump nozzles.
- Abrupt cross-section transitions or sharp bends should be avoided.

3.1.1 Installation sketch

(see sketch 3.1)

3.1.2 Suction or feed line

The distance between pump suction flange and tank button should be not less than 60 mm.
The minimum tank level is a the result of the NPSH value in the pump performance curve, it means distance suction flange of the pump to liquid level.
If dirty particles are anticipated or if contaminated liquids are to be pumped, a filter should be installed in the pipeline whose free-space sectional area should be at least three times the cross-sectional area of the nominal suction line diameter. The mesh size should be 0.1 mm.

3.1.3 Discharge line

For operating point adjustment, a regulating valve must be installed downstream from the pump. A non-return valve should be used, it should not close abruptly. Pressure surges should be avoided.

A air vent valve installed after the pump is necessary to exhaust the air before the first commissioning.

3.1.4 Installation of orifices

- **Q-max orifice**

If the differential pressure is below 1 bar to two bar a Q-max orifice must be installed in the discharge line in order to avoid flowrates in excess of permissible values.
If operation is not beyond the permissible max. flowrate, lubrication of the plain bearings will be satisfactory and unimpaired removal of the thermal losses from the magnetic-drive coupling is ensured.

- **By pass valve**

CAUTION

To save the pump for dry running damages a by pass valve is requested.
Open pressure is depended of following condition:

- Max motor performance, see performance curve.
- Max allowed differential pressure, see performance curve.
- 1 bar above duty point

The open pressure shouldn't be higher than necessary, this reduced motor energy consumption.

- **Q-min orifice or overflow valve**

An overflow valve or a Q-min orifice can be installed in the discharge line in order to avoid flowrates below permissible values (see installation sketch). This will ensure sufficient cooling of the magnetic-drive coupling.

3.1.5 Pressure monitoring

In order to monitor the pressures upstream and downstream from the pump, measuring points in the suction and discharge lines should be installed (see installation sketch).

3.2 Electrical connections

The electrical connection for the driving motor must comply with all relevant rules and requirements.
With star-delta starting of centrifugal pumps, the change-over from star to delta is likely to involve a higher supply system loading than direct delta starting. Moreover, the acceleration torque resulting from switching will lead to a moment surge which may result in decoupling. For this

reason, direct connection is preferable in particular for pumps having a great moment of inertia. However, authorisation by the competent energy supply company is required, as star-delta connection is often mandatory above a certain motor power limit. If direct connection is not possible the use of a more powerful magnetic-drive coupling or a soft starter motor may be necessary (also see section 3.3.4).

3.3 Accessories

The following accessories are available for this pump:

- Motor load monitor
- Temperature probe (PT100)
- Level transmitter
- Soft starter motor

3.3.1 Motor load monitor

The motor load monitor monitors the electric power consumption of the driving motor. If, for example, power consumption is too high due to the rotor being blocked, or decreasing due to desynchronisation or decoupling, an error message or an emergency stop can be generated. In the event of magnetic decoupling, coupling damage and excessive surface temperatures are prevented. The monitor will also detect flowrates outside the permissible range.

3.3.2 Temperature probe

A temperature probe can be connected to the can support disc to monitor the can temperature. The response temperature setting should be 10°C above the temperature of the liquid handled. In the case of variable temperature conditions, please contact Sterling SIHI.

3.3.3 Level transmitter

A level transmitter can be installed on the pipeline upstream from the pump in order to ensure the liquid level is sufficient during pump operation.
As an alternative, a flow control instrument can be installed in the discharge line.

3.3.4 Soft starter motor

In general, pumps of this type have a magnetic-drive coupling strong enough to transmit the acceleration torques in the case of direct starting of the electric motor. A soft starter motor reduces the acceleration torques and it may therefore be possible to use a lower-cost coupling having a lower torque at rated load. Lower eddy-current losses reduce the energy consumption of the pump, thus improving efficiency of the set.

3.4 Pumping of liquefied gases

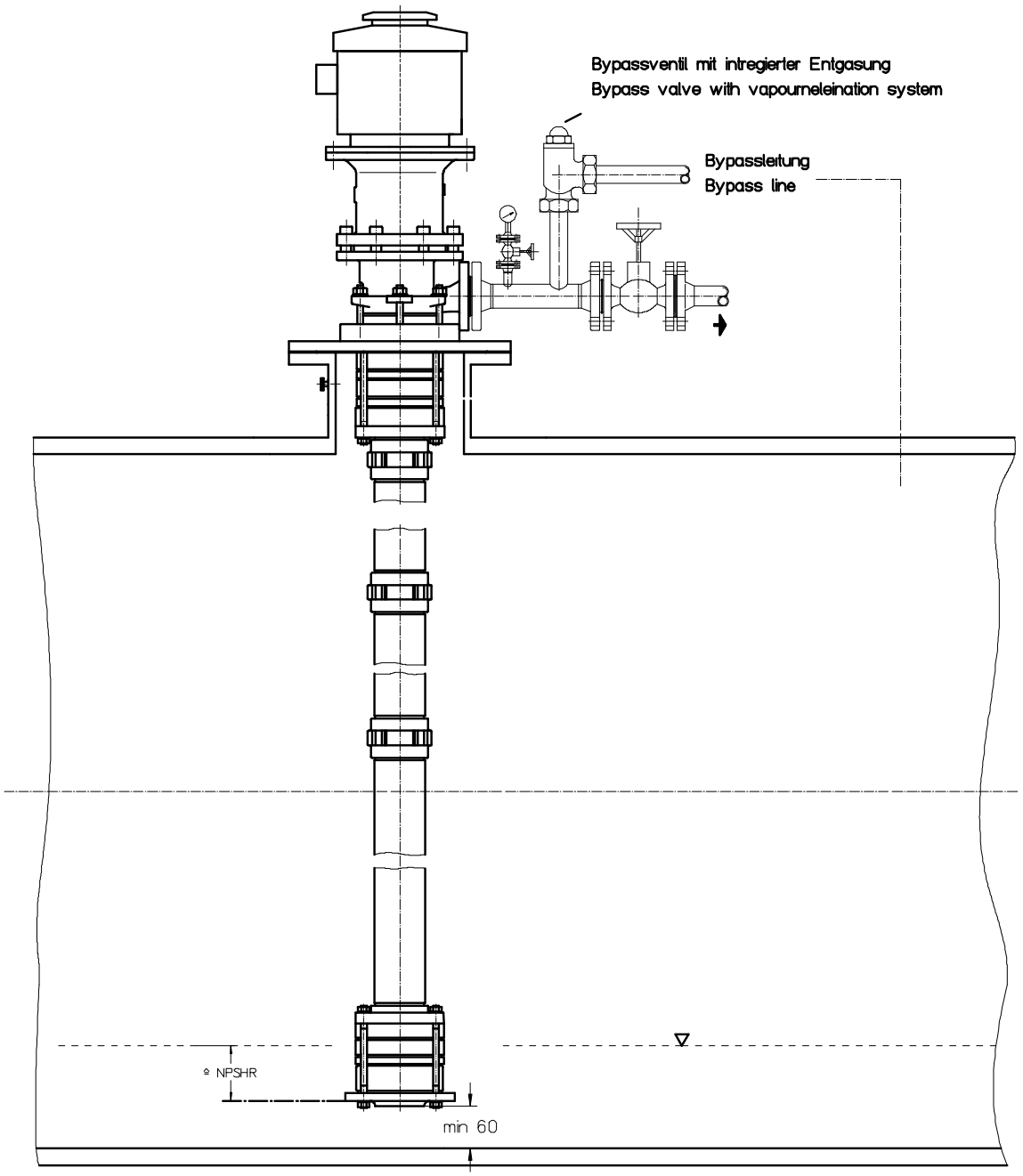
Faults during the start up of the pump nearly always lead to op-erating troubles by defective pump parts because of dry running. Therefore it must be especially ob-served:

- that the flow resistances in the suction line are kept as low as possible
- that, directly before the pump inlet, the flow is not disturbed by a bend, filter, valve or cross-sectional changes.
- that the inflow head indicated for this project (energy head at the inflow branch of the pump in m lc above the vapour pressure) at the suction branch is absolutely adhered to
- by-pass lines from the discharge side to the suction side of the pump are not admissible. The by-pass return flow from the overflow valve has to be returned to the inflow container
- When draining several tanks with one pump it must be ensured that the pump handles no gas along with if one of the tanks is drained earlier than the other ones.
- Before each start it must be absolutely ensured that the tank is filled with enough liquid.

For the control of the pump against dry run during operation and for the guarantee of a sufficient liquid storage in the pump, the installation of a level or pressure control device is recommendable.
For the use in ranges with Ex-danger the additional devices must correspond to the valid safety rules.
With a regulating armature which is fully opened there is the danger that the pump operates beyond the admissible operating range and by this vaporization can arise in the pump, especially inside the isolation shroud.

3.5 Tank installation

For small tank capacity which can handle a service car, a direct installation is possible (sketch 3.1).


Bypassventil mit intregierter Entgasung
Bypass valve with vapourneleination system
Bypassleitung
Bypass line
≙ NPSHR
min 60

Sketch 3.1

4 Unpacking, handling

4.1 Safety measures

- Do not lift heavy equipment overhead of personnel.
- A safe distance must be kept when lifting and moving the equipment.
- Use only approved and suitable lifting equipment.
- The length of the lifting equipment should be such that the pump or the set are lifted in horizontal position.
- Do not attempt to lift the pump or the pump set using eyebolts on pump components.
- Do not remove any documents from the pump.
- Do not remove protection covers from the pump nozzles, as they prevent contamination of the pump.
- Handle the pump with care. It is equipped with plain bearings which are susceptible to shocks and impacts.

4.2 Unpacking

The equipment should be inspected visually before it is unpacked. Report any damage occurred in transit on the counterfoil or delivery note. Claims should be made immediately on the carrier or the transport insurance.

4.3 Intermediate storage

If the pump or the pump set is not to be installed immediately it should be stored in a dry and vibration-free room.

4.4 Preservation

A preservative coating has been applied to the pump; see tag affixed to the pump. Re-preservation may be necessary.

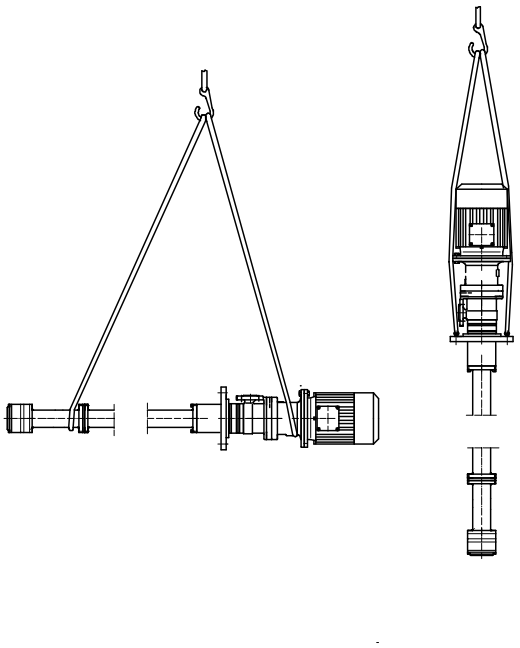
4.4.1 Removal of preservative agents

The preservative must be removed in accordance with the information on the tag and disposed of as required by applicable regulations.

4.5 Lubricants and auxiliary material

If the order has not been expressly for an oil-free and grease-free pump, grease and mounting pastes have been used during pump assembly. If residual material of this must not come into contact with the liquid handled, clean the pump using a cold cleaner, before it is installed in the system.

4.6 Handling



Lifting pump with motor

5 Mounting of the pump

Caution 

Please also refer to **chapter 9 – Installation Instructions SIHI LPG pumps.**

5.1 Prerequisites

Prior to installation the pump or pump set must have been unpacked and transported in accordance with the instructions under Section 4.

5.2 Target group

The work described in this section must be carried out by instructed skilled personnel only.

5.3 Safety measures

- The pipework must be properly installed. Fluid leakage during pump operation could cause health hazards.
  Remove the pump nozzle caps just before installing the pipelines.
- The shut-off valves in the suction or feed line and the regulating valve in the discharge line must be closed.
- All internal rules and guidelines must be complied with.

- Electrical connections must be in compliance with the applicable local rules, guidelines and requirements. This work must be carried out by authorised personnel.
- Disconnect power to the equipment so as to eliminate electrical shock hazards!

5.4 Assembly tools

Special tools are not required for erection and installation.

5.4.1 Permissible surroundings and ambient temperatures

Ambient temperatures between -20°C and +40°C are permissible.

With other - in particular higher ambient temperatures, adherence to temperature category specifications as stated in Section 9 is not ensured. With regard to the applicable temperature category for operation in potentially explosive atmospheres with ambient temperatures in excess of 40°C, please contact Sterling SIHI.

5.4.2 Tank installation

The pump installation is vertical at the top of the tank.
The tank flange must be stable enough to handle all forces, pump weight, pipe forces and motor inertia moment.

5.4.3 Space utilisation

For the space required by the pump, see the table of dimensions or the arrangement drawing.

Provide easy access to the shut-off and regulating valves and the measuring instruments.

5.5 Preparatory checks

Before installing the pump in the system, check the following items:

- Driving motor disconnected from electrical power sources?
- Suction or feed line and discharge line empty and locked?
- Check that the shaft is free to rotate by hand (by turning the motor fan wheel).
- If there are any internal regulations - have they been complied with?
- Has the preservative been removed in accordance with the instructions on the pump tag? Non-observance could lead to plant contamination.

5.6 Installation

– Clean and blow out anchor holes.
– Clean the flange surface.
– Check positions and dimensions of anchor holes against the arrangement drawing.
– Install the pump with the seal.
– Check whether the pump casing is free.
– Tighten the nuts of the flange bolts in diagonal sequence (after the grout has set).
– Connect the pipe according the installation drawing chapter 4.

5.7 Installation of the pump in the piping system

With pump mounted on the tank, release the fastening bolts of pump before connecting the pump to the pipework.
Tighten the bolts in the following sequence:

5.8 Protection and control devices

Install and connect the existing protection and control devices in accordance with the corresponding instructions (see also Section 3.3).

5.9 Completion work

Finally, carry out the following work:

- Check connecting flanges for leaks.
- Check that pump is free to rotate (by turning the motor fan wheel).

5.10 Hydrostatic pressure test

When conducting a hydrostatic pressure test on the piping system ensure that no foreign matter, such as welding beads, enter the pump.
Observe test and nominal pressures of the pump.

5.11 Monitoring of the pump

To protect the pump for overheating and dry running damages a pump monitoring is necessary.

5.11.1 MOTOR LOAD DETECTOR HPL 110

The load detector HPL 110 protects effectively the pumps against damages caused by dry operation, closed valves, cavitations etc.
The instrument operates according to a patented procedure.
It is directly integrated into the supply line of the drive motor and is measuring at first the power input into the motor and then is carrying out the correction of the measured value, which becomes necessary because of internal motor losses. This means that the measured value is corrected automatically in case of line voltage changes, so that the pump monitor records continuously the power output of the electric motor to the shaft.
The correcting function can be adjusted in such a way that it is suitable for asynchronous motors of all types and construction sizes.
With the help of 3 keys located on the front panel the standard range of operation of the pump is determined. If the load exceeds the pre-set limits, the internal max. or min. relays are actuated.
These contacts are applicable for further action.

In case the motor current exceeds 8 A a converter is to be applied. Below 8 A the pump monitor can be directly connected into the motor supply.

5.11.2 Monitoring differential pressure

A pressure indicator or a monometer with a switch contact can monitoring the minimum differential pressure. If the differential pressure is less than 50% of the normal duty pressure or below 2 bar a time contact stopped the pump after 20 –30 sec.
To avoid problems with to high pressure differences between summer and winter a second indicator installed on the tank vapour phase can consider different vapour pressures.

5.11.3 Monitoring of temperature

<u>Overheating of the magnetic coupling</u>

If no liquid cooled the pump the temperature of the magnetic coupling increase very fast. In this case a can temperature monitoring can
NIVOTHERM 2000
The switching instrument NIVOTHERM 2000 is a safety measuring transducer for the control of temperature and/or limiting values in areas with explosion hazard. The testing circuit is an intrinsically safe one. The limit value transmitter must be equipped with a switching contact for level or pressure control. As level transmitter can be used a magnetic float switch, as temperature probe a Pt-100 resistance thermometer.
During normal operation the LCD indicates the actual value of temperature. The NIVOTHERM 2000 switches off the unit to be controlled if the adjusted limit temperatures are exceeded.
The switch temperature should be 10 – 15°C above the normal highest duty fluid temperature.
Trouble is indicated by LED's.

Temperature probe PT 100
The PT 100 is a temperature dependent resistor. The resistance can be recorded by a measuring transducer and converted into a signal proportional to temperature.

PT 100 with terminal head for the control of pumps with magnetic couplings outside of the can.

5.11.4 Monitoring of flow

LIQUIPHANT FTL 51 and NIVOTESTER FTL 325
Installation in the discharge pipe. The LIQUIPHANT is a measuring transmitter for level detection for direct in pipe lines containing liquids with temperatures between - 40 °C and + 120°C and a max. viscosity of 10.000 mm²/s. Applicable in all positions where up to now float switches were used, but also where float switches were not suitable because of deposits, turbulence, flows and air bubbles. The symmetrical vibrator of the LIQUIPHANT FDL is stimulated piezoelectrically in its resonance frequency. Its frequency changes when it immerses in liquid. The installed green LED is lightening when the vibrator is free. When the vibrator is immersed the LIQUIPHANT signals this via a two-wire circuit by PFM signal to the NIVOTESTER .
By the NIVOTESTER the LIQUIPHANT is supplied potential free and intrinsically safe with direct current, the incoming signal is monitored and evaluated.

6 Starting and stopping

Caution 

Please also refer to **chapter 9 – Installation Instructions SIHI LPG pumps.**

6.1 Prerequisites

The pump or pump set must have been installed in accordance with the instructions of Section 5.

6.2 Target group

The work described in this section must be carried out by instructed skilled personnel only.

6.3 Safety measures

- The pump must be completely filled with liquid as there is danger of destroying the plain bearings and the can temperature could exceed the permissible limit.
- Check the direction of rotation only with the pump primed.
- Ensure that people and the environment are not put at risk through explosive, toxic, hot, crystalline, or acid liquids handled.
- The flowrate should be changed, after reaching constant speed, on the discharge side only. During operation the shut-off valve in the suction or feed line should always be fully open in order to avoid cavitation.

6.4 Filling

Before the first start the pump must completely be filled with the pumping medium in order to avoid dry operation of the pump. In case suction times of more than 30 seconds should be expected, the suction casing must be filled before starting. Thus an overheating of pump as well as damage to the bearing are avoided.
To exhaust the air before the first commissioning please open the air vent valve installed after the pump and close it if liquid phase is visible

6.5 Electrical connection

Connect the motor in accordance with the motor operating instructions.

6.6 Connecting and checking accessories and monitoring equipment

For the connection and checking of the monitoring equipment and accessories, follow the operating instructions of the instruments and devices.

6.7 Checks before start-up

Before starting the pump set, carry out the following checks:

- Are all pipelines connected and the connections leakproof?
- Is the pump correctly primed?
- Is the regulating valve in the discharge line fully open?
- Is the shut-off valve in the suction or feed line fully open?
- Is the motor ready?
- Is the direction of rotation of the motor correct? (Check by momentarily switching on the motor.)

6.8 Starting procedure

Proceed as follows:

1. Switch on the motor.
2. Check the pressure gauges at the pressure measuring points. If there is no continuous increase in the delivery pressure as the speed increases, stop the motor and carefully bleed all air from the pump.
3. Once the operating speed has been reached, open the regulating valve in the discharge line to adjust the duty point of the pump.

Operation with the regulating valve closed will lead to a considerable temperature increase as all energy consumed by the pump is converted into heat. High temperatures are quickly generated especially in the area of the metal can. For this reason, operation with the regulating valve closed is only permitted if the minimum flowrate is ensured through a bypass line.
The customer is to provide adequate safety measures (e.g. overflow valve) to ensure that the permissible pump casing pressure is not exceeded as a result of malfunction during operation.
Before restarting, check that the pump rotor is at rest, as otherwise, decoupling could occur.

6.9 Further notes

In order to check the correct operation of the pump a regular inspection routine should be set up to check, for example, the following quantities:

- Head or differential pressure
- Power consumption
- Flowrate
- Can temperature.

CAUTION 

In the event of decoupling (motor and outer magnet rotate without the pump following), switch off the motor, eliminate the cause and restart the set.
Operation with the magnetic-drive decoupled will damage the coupling and lead to high surface temperatures on can and outer magnet. Appropriate devices, such as a motor load monitor, can be used to detect a decoupled condition, which will cause motor power consumption to fall sharply as the motor only drives the outer magnet, i.e. just provides the energy needed for the losses generated.

6.11 Stopping procedure

Proceed as follows:

1. Switch off the motor.
2. Close discharge side regulating valve.
3. Close suction side shut-off valve.

When there is any possibility of freezing, drain the pump. Apply a preservative coating, if necessary.

7 Maintenance and assembly

Caution 

Please also refer to **chapter 9 – Installation Instructions SIHI LPG pumps.**

7.1 Prerequisites

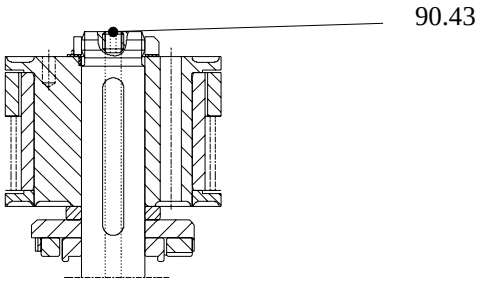
The pump or pump set must have been taken out of operation in accordance with the instructions under Section 6.

7.2 Target group

The work described in this section must be carried out by instructed skilled personnel only.
Work on electric components and connections must be carried out by authorised staff.

Attention :

If you change the shaft 21.00 don't forget orifice 90.43



7.3 Safety measures

- Magnetic-drive coupling pumps contain powerful permanent magnets. Keep data carriers and electronic components away from dismantled components. There are still uncertainties with regard to the effect magnetic fields have on **pacemakers**. For reasons of safety, the people concerned should not be involved in assembly work on magnetic-drive pumps. The range of the magnetic fields is a few decimetres. Once the magnetic components are installed, they are screened.
- The space between stored magnetic coupling components must be sufficient to prevent the danger of injuries caused by attracted parts.
- The workplace for assembly or disassembly must be clean and non-magnetic.
- When the pump has been removed from the system drain it. Flush the pump with an adequate liquid to remove any residual liquid.

7.4 Maintenance and inspection

Depending on the pump design, the plain bearings installed are silicon carbide / silicon carbide bearings (stationary bearing bushes and rotating bearing bushes in SiC) or consist of stationary carbon bushes in the casing and rotating SiC bushes. The actual construction is given by the pump type designation; for code explanation, see Section 2.
In the case of bearings consisting exclusively of SiC, wear will be kept to an absolute minimum which is hardly measurable. However, we recommend that the plain bearings be inspected after 8000 operating hours or two years.
Depending on the physical properties of the pumped liquid, a hard/soft SiC/carbon combination will result in moderate to heavy wear on the carbon bush, in particular on the running surface of the thrust bearing. A reliable statement with regard to the service life of the bearings, irrespective of the pumped liquid, is not possible. If liquids with waterlike properties are pumped, the service life will be at least two years provided the operating specifications are adhered to.

Required values for radial bearing clearance:
SiC/SiC
Minimum: 0.05 mm
Maximum: 0.1 mm
Carbon/steel:
Minimum: 0.05 mm
Maximum: 0.2 mm

There are oil grooves in the running surface of the thrust bearing in the carbon bush. The groove depth of a new bearing is 2 mm and will decrease as wear takes place on the bush. The minimum permissible groove depth is 1.9 mm.
Replace the bearing bushes, if wear has gone beyond this limit.

7.5 Disassembly

7.5.1 Preparation

- Disconnect motor from electrical power sources.

- Drain system, at least in the area of the pump, i.e. between suction and discharge side shut-off valves.
- If necessary, disconnect and remove any sensors or monitoring devices (if installed).

7.5.2 Replacement parts

When ordering spare parts, please indicate the item numbers as specified on the sectional drawing, the serial numbers and the complete type designations.
When reassembling the pump, always replace the casing gasket.

7.5.3 Disassembly motor and tank internal pump parts

(Refer to sectional drawing)

- Mark the position of the stage casing to each other by means of a colored pin or a scribing point. This facilitates the adherence to the circuit diagram during the reassembly.
- In order to separate the motor from the pump, unscrew screws 90.10 and draw off the motor with the outer magnet mounted to its shaft end.
- After loosening the shaft screw 90.60 the magnetic bell can be removed from motor shaft end. After loosening the screw 90.12 taking off the magnetic bell can be removed from motor shaft The lantern 34.60 can be disassembled after loosening the nuts 92.02.
- Lose screw 91.46 and replace pump part below flange 01.01
- To avoid damages on the shaft carbon bearings, please disassemble in a vertical position.
- Lose shaft nut 92.20.
- (Attention left hand thread).
- Loose screws 91.43 and pull all components 23.10, 10.60 to 11.42 from the shaft.
- Lose nut 92.01 and separate intermediate pipe 71.11 from 71.10.
- Remove coupling 84.00. Remove bearing carrier 38.20.
- Repeat it with every pipe shaft segment.

7.5.4 Disassembly of the upper pump part

For the disassembly of the pump it is useful to place it in the stool 34.60, which is standing on its flange at the motor side.
The disassembly starts at the suction side.

- Lose nut 55.00 and replace flange 01.01
- Dismount now alternately the suction intermediate pieces 10.90 / 10.91, vane-wheel impellers 23.50, keys 94.01 as well as pressure intermediate pieces 11.40 / 11.41.
- Unscrew the screws 90.13 and take off the discharge casing 10.70 together with the flange for can 81.71, the isolation shroud 81.70 and the shaft.
- Unscrew the screws 91.40 and take off the flange for can 81.71 and the isolation shroud 81.70
- Remove shaft 21.00 completely with interior magnet from the discharge casing 10.70. Attention: Keep away ferrous parts from the interior magnet.
- Loosen shaft nut 92.21 and remove the interior magnet 84.71, the thrust bearing 31.40, the spacers 52.51 and the bush 52.91 from the shaft.
- Loosen the screws 91.42 and take the bearing insert 38.10 off the discharge casing 10.70, if necessary.

7.6 Work after disassembly

7.6.1 Cleaning

- Clean all parts.
- Use a suitable diluting agent to clean wear rings and sealing surfaces.
- Remove metal particles from the magnet by means of adhesive tape.
- Check if the orifice 90.43 in shaft 21.00 is clean.

7.6.2 Control notes

- Check the SiC-sleeve bearings for damages and wear. Should they be damaged, they must be replaced.
- Check the wear ring surfaces of the impeller 23.10 for damages and wear. The diameter difference between wear ring at the impeller and casing parts shall be 0.3 mm - 0.5 mm. In case the wear rings have been worn out too much, they must be replaced.

- **Intermediate pieces 10.90, 10.91, 11.40, 11.41**
  The running surfaces can be returned up to 0,5 mm. During this pay attention to the plane parallelism. Max. admissible peak-to-valley height is Rt = 6 µm, deviations from the plane parallelism 10 µm. With intermediate piece 10.90 the sealing surface must be readjusted in order not to change the vane-wheel impeller play. The depth must be for the sizes
  0,210 up to 0,180 larger than the width of the vane-wheel impeller.

  It is recommendable to readjust/refinish only as much as necessary (power difficulties). With multi-stage pumps and an efficient utilization of the full recess/boring extent, perhaps new and old stages (mixed) are to be installed in order to avoid power- and assembly difficulties (shaft length!).

- **Vane wheel impeller 23.50**
  From a reworking of the vane-wheel impeller should be always refrained as a reduced output not to be foreseen can arise and thus the interchangeability is not ensured anymore.

7.7 Assembly

7.7.1 Tightening torques

The following tightening torques apply (in Nm):

M8	M10	M12	M16	M20	M24x2
12	25	40	90	175	300

Tightening torque for shaft nut: 20 Nm

The screws between the flange for the can 81.71 and the discharge casing 10.70 (item 91.40) have to be tightened with the following torques:

thread M8: 20 Nm
thread M12: 70 Nm

7.7.2 Pump assembly

The running surfaces of the vane-wheel impellers should be provided with Molykote paste G.
The pump is sealed with sealing liquid “0” or with soft teflon cord “4”. The contact points of the cord must overlap approx. 10 mm. In order to facilitate the assembly the cord can be „glued on“ with grease.

- The circuit diagram (see annex) must be absolutely observed in order that operating safety and function are ensured.
- Mount the pump by making the work described under disassembly in reverse order. Screw up tie bolts 90.22 / 90.50 only by hand.

Attention:

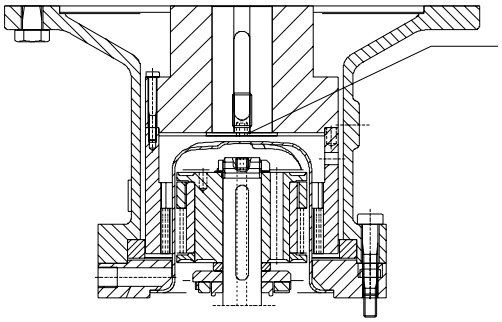
Due to the magnetism of the magnets the outer magnet will „suddenly“ jump the inner magnet. Therefore do not touch between the flanges of motor and stool as otherwise there is the danger of injury when mounting the motor to the stool.

- After having screwed motor and stool, the pump is placed on an even base support (leveling plate) and it is aligned. Discharge and suction flange are to be aligned by means of a water balance. Then the tie bolts are tightened crosswise with a torque wrench.

7.8 Checks after assembly

- Check that pump is free to rotate by turning the motor fan wheel.
- To ensure the strength of the casing components is sufficient, a bursting test on the pump at 1.5 times the nominal pressure is recommended.
- Carry out a leak test.

Attention!



1.)Tight shaft screw 90.60 and safe with Loctite 222.

8 Help in case of trouble

8.1 Target group

Remedial action should be performed by instructed and qualified personnel only.

Trouble	Cause	Remedial action
Insufficient liquid delivered	- Counter-pressure too high.	Re-adjust the operating point. Check the system for contamination.
	- Residual gas in pump or pipeline	Bleed the air and fill pump and suction or feed line.
	- Suction lift too high or insufficient NPSHA	Check liquid levels, open suction side shut-off valves. Clean suction side filters and dirt traps.
	- Sealing clearances too great due to wear.	Replace worn pump components.
	- Wrong rotation	Re-connect the motor, interchanging two of three supply wires.
	- Pipe resistante too hight	Clean the filters and dirt traps installed at suction side
	- Leakage in casing or suction pipework.	Replace casing seal. Check flange connections.
No liquid delivered with motor in operation	- The max. torque of the magnetic coupling has been exceeded, i.e. decoupling has occurred.	Check adherence to operating conditions on which the pump design is based. The max. permissible density and/or viscosity of the liquid handled may have been exceeded. Check that the allocation magnetic coupling - motor - pump is in accordance with the data sheet. Check if the pump is blocked by contamination. (Check if pump turns freely.) Check internal plain bearings.
	- Pump not filled or liquid contains too much gas	Bleed the air and fill pump . Check the pressure balancing pipe between pump casing and tank. If the pumps is installed in a barrel, please check the pressure balancing between barrel and tank. I case of different temperatures vapour can displace liquid completely.
Pump leakage	- Leakage in casing seal	Check tightening torque of tie bolts.
	- Defective seals	Replace the seals.
Temperature increase in the pump	- Residual gas in pump or pipeline	Bleed the air and fill pump and suction or feed line.
	- Suction lift too high or insufficient NPSHA	Check liquid levels, open suction side shut-off valves. Clean suction side filters and dirt traps.
	- The filtering screen for the partial flow installed in the pump is dirty	Dismantle the pump and clean the filtering screen.
Unsteady running of pump, excessive noise	- Suction lift too high or insufficient NPSHA.	Check liquid levels, open suction side shut-off valves. Clean suction side filters and dirt traps.
	- The max. torque of the magnetic coupling has been exceeded, i.e. decoupling has occurred.	Check adherence to operating conditions on which the pump design is based. The max. permissible density and/or viscosity of the liquid handled may have been exceeded. Check that the allocation magnetic coupling - motor - pump is in accordance with the data sheet. Check if the pump is blocked by contamination. (Check if pump turns freely.) Check internal plain bearings.
	- Residual gas in pump or pipeline	Bleed the air and fill pump and suction or feed line.
	- Pump distorted	Check pump installation and alignment.
	- Foreign matter in the pump	Dismantle and clean the pump

Trouble	Cause	Remedial action
Motor load monitor response	**Power consumption below adjusted lower limit value, as a result of:**	
	- Decoupling of magnetic coupling	Check adherence to operating conditions on which the pump design is based. The max. permissible density and/or viscosity of the liquid handled may have been exceeded. Check that the allocation magnetic coupling - motor - pump is in accordance with the data sheet. Check if the pump is blocked by contamination. (Check if pump turns freely.) Check internal plain bearings.
	- Flow rate below the min. permissible level	Check the operating point.
	Power consumption in excess of adjusted upper limit value, as a result of:	
	- Flow rate above permissible max. level	Check the operating point.
	- Increased friction in the pump	Check that pump turns freely. Check internal plain bearings. Check if the pump is blocked by contamination.
Motor circuit breaker switches off	- Increased friction in the pump	Check that pump turns freely. Check internal plain bearings. Check if the pump is blocked by contamination.
	- Requirements as to pumping conditions not met.	Check the operating point.
pump is not able to lift liquid	• Positive suction head too low resp.	check the tank liquid levels ,
	• wear on the intermediate peaces and the vane wheel impellers axial play of the vane wheel impellers too big	check the axial play, see notes in chapter 7
	• wrong sense of rotation	check the connection of the motor
	• not enough liquid inside the pump	fill up the pump with pumping medium
	•	

9 Technical data

CAUTION

Temperature of liquid handled: -40°C to 120°C
For fluid temperatures below 0°C, a closed lantern is used. A soft teflon cord is used as a seal between lantern and can support disc / motor flange. This minimises the entry of air moisture and so prevents the outer magnet from freezing on the can as a result of freezing condensation water when the pump is at rest.

Surface temperature: The pump surface temperature largely depends on the temperature of the liquid handled. Hence, temperature categories can only be defined in relation to the temperature of the fluid (see table below). The values in the table below refer to a max. ambient temperature of 40°C. For higher ambient temperatures, please contact Sterling SIHI. The operating limits for the pump must be observed. For monitoring purposes, the use of a temperature probe is recommended. It should be installed on the can, where the highest temperatures occur as a result of eddy current losses of the magnetic coupling. Generally, direct installation of the motor on the pump does not limit the applicability of the set in potentially explosive atmospheres. According to measurements carried out by Sterling SIHI, the temperature on the front motor bearing will not exceed 80°C . In the event of fluid temperatures above 80°C, the temperature category of the set is determined by the pump, not by the motor.

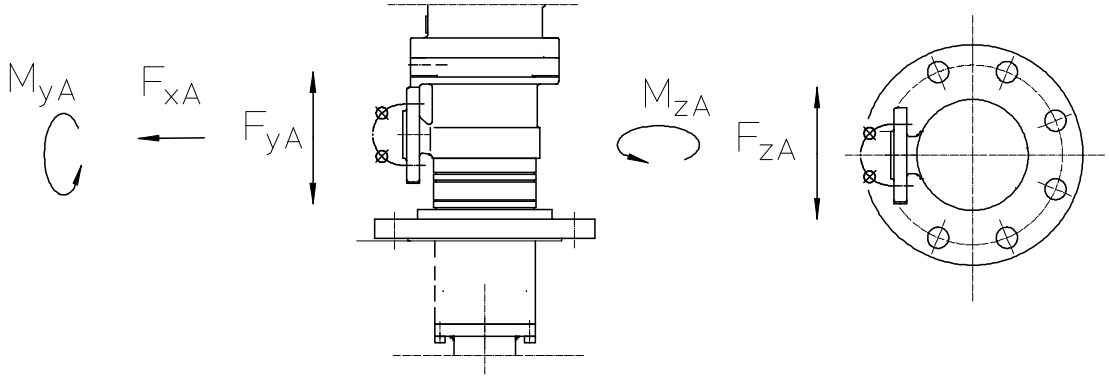
Temperature category according to EN 13463-1	Permissible surface temperature	Max. permissible temperature of the liquid handled
T1	450 °C	400 °C
T2	300 °C	275 °C
T3	200 °C	175 °C
T4	135 °C	110 °C
T5	100 °C	75 °C

Kinematic viscosity: For reliable pump operation, the kinematic viscosity of the liquid handled at operating temperature must be between 0.3 mm²/s and 300 mm²/s. The viscosity must be considered when designing the magnetic coupling. Special constructions may be possible for applications involving lower viscosity levels; in this case, please consult Sterling SIHI.

Casing pressure: pumps with magdrive system 1, 2 or 3: PN 40 (CEB 2000)
Pumps with magdrive system 4: PN 25

Rotation: left when viewed from drive end.

Admissible branch forces: The maximum admissible branch forces and moments can be seen in the following table



In the case of more single forces which are acting simultaneously, the components of the resultant of these forces are not allowed to exceed the admissible values of the respective force directions . The pump feet must be fast tighten plane and uniform with the ground plate. If these conditions are not respected, no guarantee can be assumed for tightness und durability .

Size	Discharge flange Pos. 10.70					
	FxA	FyA	FzA	MxA	MyA	MzA
	[N]			[Nm]		
2000	200	400	200	140	75	140

Sound emission: According to EUROPUMP Tech 001/30/D, the sound pressure level of the pump for powers < 100kW is calculated using the following equation:

$$L_P = L_{WA} - L_S = \left(66 + 13{,}5 \lg \frac{P}{P_0}\right) - \left(25 + \lg \frac{P}{P_0} - 3 \lg \frac{n}{n_0}\right) = 41 + 12{,}5 \lg P + 3 \lg n$$

LP:	Sound pressure level at measurement surface	dB
LWA:	Sound pressure level	dB
LS:	Measuring surface dimension	dB
P:	Pump power input	kW
P0:	1	kW
n:	Pump speed	rpm
n0:	1	rpm

9.1 Materials of construction

		Material design				
Pos.	**Part**	**1A**	**1B**	**1F**		
10.60 10.70 10.80 10.90 11.40 11.41	Suction casing Discharge casing Intermediate piece	GGG 40.3 (0.7043)				
21.00	Shaft	1.4021				
23.10	Impeller	GG-25 (0.6025)				
23.50	Vane wheel impeller	2.0550	1.4027 05	PAEK		
0242	Bearing bush	Spezialkohle				
31.40 52.90 52.91 54.00 54.00	Axial bearing Sleeve Bearing bush	SiC				
34.60	Latern	GG-25 (0.6025) or 1.0570				
35.50	Bearing carrier	GGG-40.3 (0.7043)			1.4408	
81.70	Can	Hastelloy C4 (2.4610), ZrO2 oder CFK (see chapter 2)				
81.71	Can flange	1.0570				
84.71	Inner magnet	1.4571/SmCo				
84.72	Outer magnet	1.0570/SmCo				
84.80	Driving flange	1.0570				

9.2 Rated load torques of magnetic couplings

The values (in Nm) are for a temperature of 20°C and indicate the torque limits beyond which decoupling occurs.

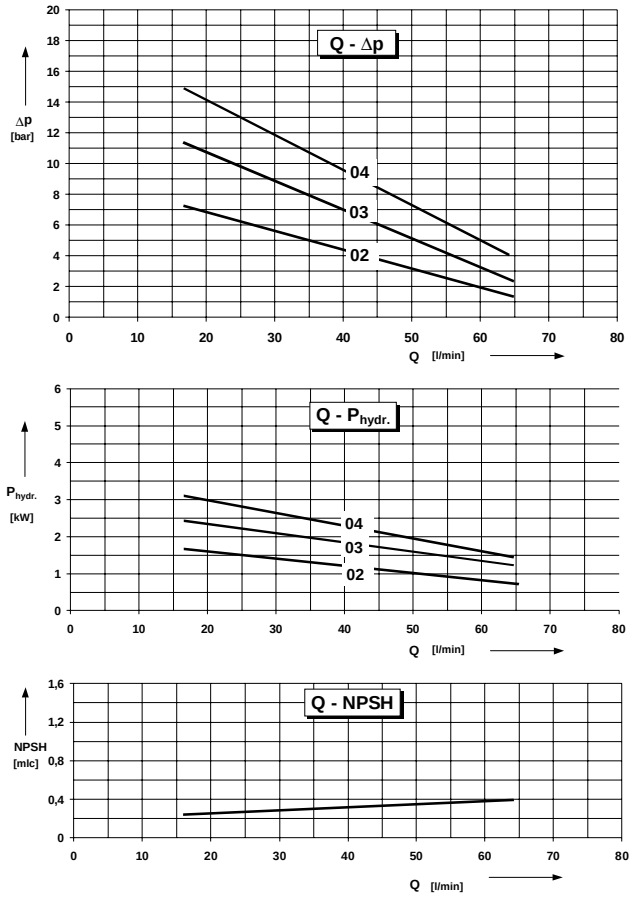
	MAGNETIC DRIVE SYSTEM						
Code	**1A, 1E**	**2A, 2E**	**2B**	**3A, 3E**	**3B**	**4A, 4E**	**6A, 6E**
A		78	57	78	57	69	69
B						83	83
C		100	73	100	73		
D				112	82		
E				158	115	133	133
F				179	131	178	178
H						212	212
J						255	255
K	14					293	
L						330	
M						380	
P	23						
T		33	24	33	24		
V	38						
W		41	30	41	30		
Z		54	40	54	40		

9.3 Minimum and maximum flowrates

CEB 2000 designed for densities up to ρ = 0,65 kg/l.

For different liquid densities the performances change as follow:

n = 2900 rpm ρ = 0,56 kg/l



Calculation for different densities:

Example :	Butane 0,6 kg/l CEB 2002
for	Q = 35 l/min P = 5 bar P = 1.4 kW
p_{Butane} =	5 bar x (0.6/0.56)
	5.36 bar
P_{Butane} =	1.4 kW x (0.6/0.56)
	1.5 kW
for Q_{Butane} =	35 l/min

9.7 Appendices - Technical data summary

When using CEB 2000 pumps, the following technical data must be taken into account.

Direction of rotation: anti-clockwise facing the end of the pump drive shaft

RP : 40 bars

Max. admissible P*: 40 bars

Test Pressure: 52 bars (1.3 times the rated pressure)

Viscosity : 0.4 to 5 mm²/s

Max. n*: 3000 rpm

**These limits are not valid for all products or all types of construction. For use in conformity and in complete safety, take into account the existing requirements (standards) concerning the type of sealing and cooling.*

Number of stages: 2 to 4 stages maximum

Connecting flanges: as per DIN 2501, PN 40, (positions and dimensions: see dimension drawing).

Bearings: Two sleeve bearings, lubricated by the pumping medium.

Lubrication: Pump medium lubricated.

Minimum / maximum output:
Refer to Chapter 2

Temperature limits
Minimum temperature of pumped liquid = - 25 °C
Maximum temperature of pumped liquid = 80 °C

Maximum permissible temperature of pumping liquid
The highest temperatures usually occur on the pump casing surface, on the bearing housing in the area of the anti-friction bearings and on the casing cover near the mechanical seal. A dry running must be prevent.

The temperature occurring on the pump casing is almost the same as that of the liquid handled

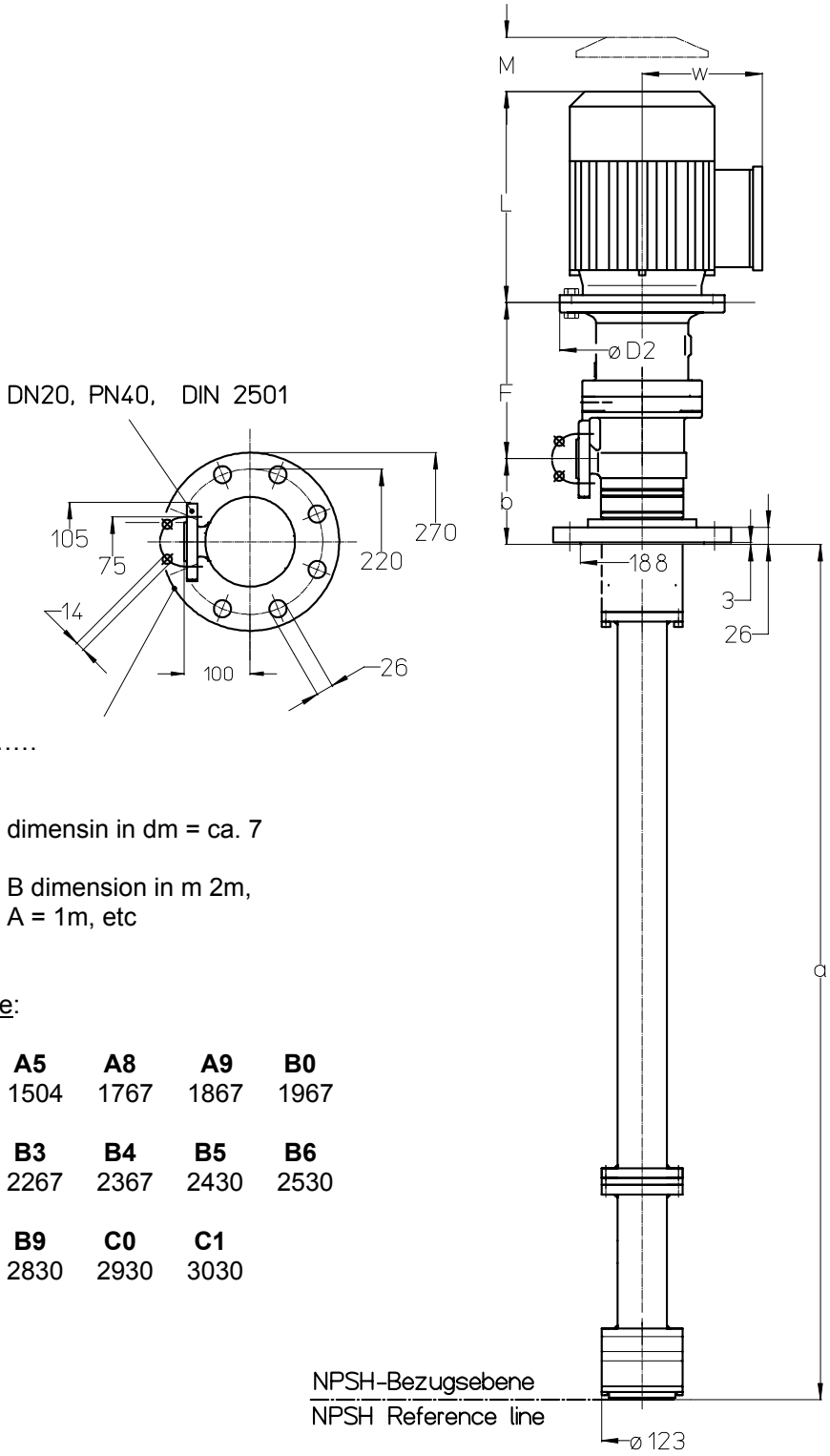
A maximum temperature of 80°C, if grease lubricated, can be expected in the area of the anti-friction bearings, provided the requirements for appropriate pump operation are met and regular maintenance on the bearings is provided. Insulation of the bearing housing is not permissible.

If the pump is adequately filled with liquid, the temperature of the liquid handled in the shaft seal area should not increase by more than 15°C for dead end operation with a single acting mechanical seal.

Thus, the following theoretical maximum temperature of the liquid handled as a function of the temperature class according to EN 13463-1 is obtained. The maximum operating temperature of the pump as well as the operating limits of the mechanical seal must be observed (if there is any doubt, please contact Sterling SIHI or the mechanical seal manufacturer).

Temperature class acc. EN 13463-1	Max. temperature of pumping liquid
T5	85 °C
T4	120 °C
T3	185 °C
T2	285 °C
T1	350 °C

CEB 2000



C E B A 2 0 0 0 **B 7** .....

dimensin in dm = ca. 7

B dimension in m 2m,
A = 1m, etc

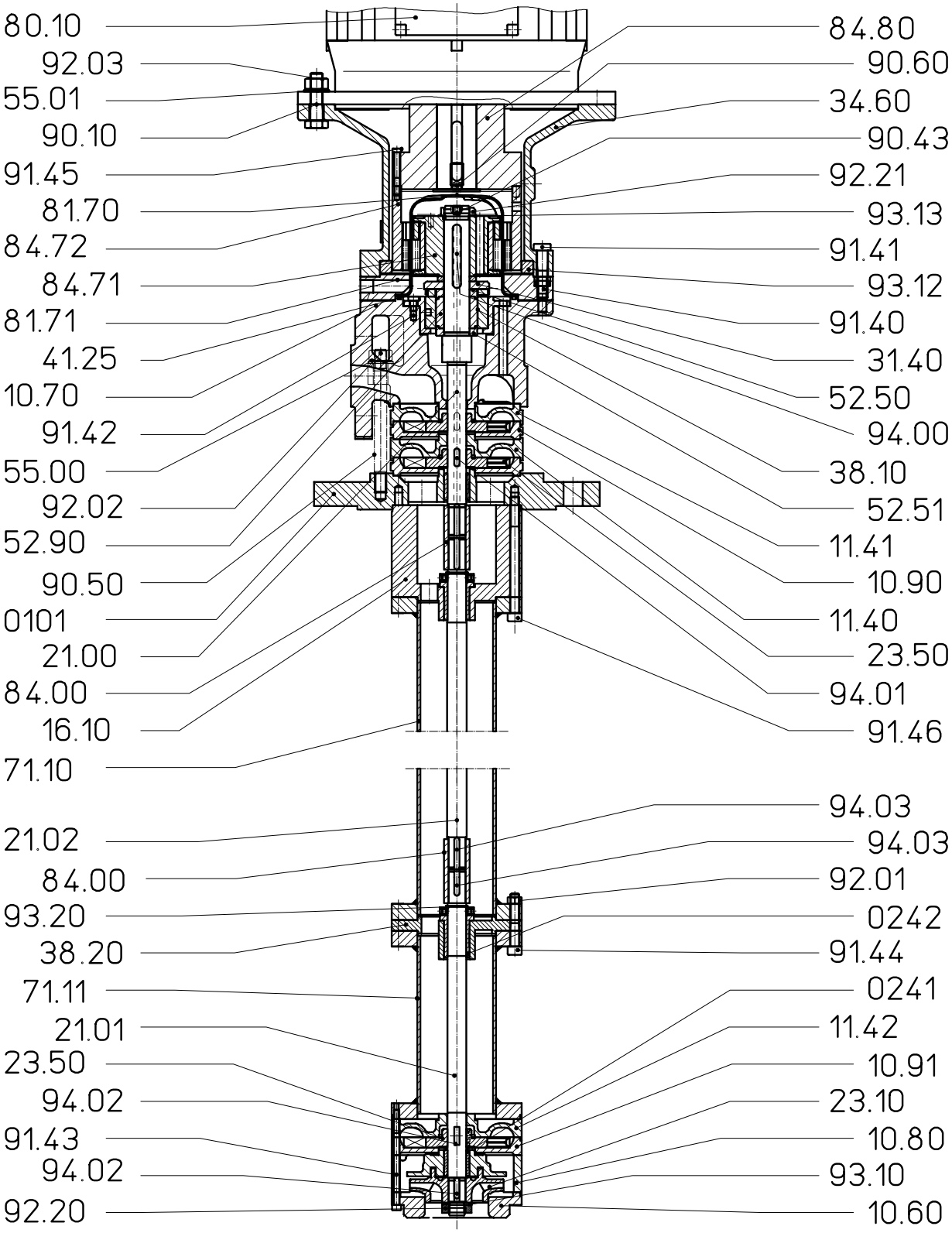
Length „a“ in pump code:

Code	**A3**	**A4**	**A5**	**A8**	**A9**	**B0**
a (mm)	1304	644	1504	1767	1867	1967

Code	**B1**	**B2**	**B3**	**B4**	**B5**	**B6**
a (mm)	2067	2167	2267	2367	2430	2530

Code	**B7**	**B8**	**B9**	**C0**	**C1**
a (mm)	2630	2730	2830	2930	3030

Motor	EEXe / EEXd	**D_2**	**f**	**W**	**f**	**L**	**M**		**Size**	**b**	**a**
100 L	3,0 / 2,5 kW	250	237	227	340	340	30		2002	126	max 3000
112 M	4,0 / 3,3 kW	250	237	239	348	348	30		2003	126	
132 M	5,5 / 4,6 kW	300	257	254	440	440	30		2004	160	


80.10
92.03
55.01
90.10
91.45
81.70
84.72
84.71
81.71
41.25
10.70
91.42
55.00
92.02
52.90
90.50
0101
21.00
84.00
16.10
71.10
21.02
84.00
93.20
38.20
71.11
21.01
23.50
94.02
91.43
94.02
92.20
84.80
90.60
34.60
90.43
92.21
93.13
91.41
93.12
91.40
31.40
52.50
94.00
38.10
52.51
11.41
10.90
11.40
23.50
94.01
91.46
94.03
94.03
92.01
0242
91.44
0241
11.42
10.91
23.10
10.80
93.10
10.60

Contents:

1.) Pumps for liquefied gases

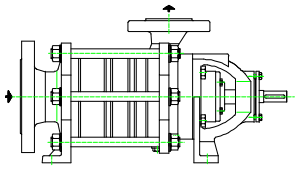
1.1 General

Modern LPG pumps reflect the latest state of technology as regards both safety and hydraulic properties.
Liquefied gases are stored at vapour point temperature. The excess pressure over vapour pressure required for safe pumping without vapour locking can only be achieved by means of static delivery heads. The greater the required pressure, the higher the costs of the system. The specific properties of liquefied gases thus pose a special challenge as regards the hydraulic capacity of the pump and the design of the overall unit. Requirements for liquefied gas pumps:

1. High pressure increase rate
2. Low NPSH values
3. Good pumping performance of vapour/liquid mixtures
4. High gas pumping rate

1.2 LPG pump types

1.2.1 Side channel combi pumps CEH, SC up to 35 m^3/h



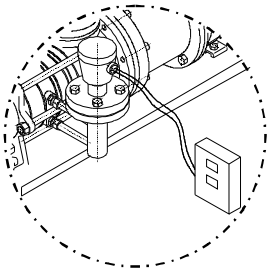
One of the most commonly used pump type for liquefied gases is the side channel pump with inducer stage.

The individual side channel sections designed to increase the pressure are installed in series with a special centrifugal stage, thus forming a combined side channel system. This type of pump combines the specific advantages of the two principles of design. The side channel stage is for example able to handle considerable gas in flooded suction applications and is self-priming. Models with attached centrifugal stage achieve excellent NPSH values.
Thanks to the combination of the above functional parts, a side channel combi pump is particularly suitable for the safe and reliable transport of liquids at near-vapour point conditions without loss of performance. The inlet and the radial suction impeller (NPSH inducer stage) have been designed in accordance with the latest knowledge in the field of cavitation, ensuring very low NPSH values. The internal product-lubricated sleeve bearing located on the suction side allows for unimpaired axial intake.
In contrast to other pump designs, our combined systems can be reliably operated with positive suction heads of less than 0.8m at pumping rates of up to 35m3/h. The pump can be easily installed on the site, keeping costs low.
Multi-stage side channel pumps with NPSH inducers are available with capacities of up to 35 m3/h and heads of up to H = 350m.
We offer a wide range of models covering specific performance range, so that operators can choose a model that is most effective for their specific needs.

Within the capacity range of a particular pump size, the number of stages is determined by the duty point. The HQ curves are relatively steep.
The gas flow is thus improved during intake. This is particularly important in LPG pumps, as the back pressure tends to fluctuate greatly as a result of changes in temperature.

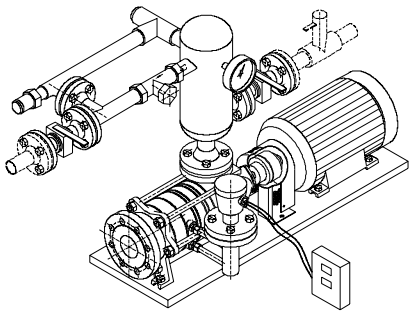
Special models (/6, /7) are equipped with a retaining stage with a built-in gate. As the CEH pumps remain filled with liquid, they are often used in PC units to pump LPG from underground storage tanks.

The housings of special pump models CEH../6 and CEH../7 are equipped with external connections for direct installation of a liquid level protection.



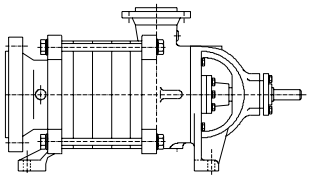
Liquid sensors ensure that the pump is switch off immediately if it is running dry.

1.2 LPG with suction lift operation PC unit up to 30 m^3/h



For safety reasons, operators prefer underground LPG storage tanks.
PC units are the ideal solution for such facilities, as they offer solutions where there is no need for the integration of moving components or entire units into the pressurised container. PC units are suitable for propane-butane mixtures with minimum 20% propane content, positive suction heads of up to 4m and tank volumes of maximum 200m^3.
They consist of a side channel pump with NPSH stage, a gas separator, a by pass valve , a differential valve, a safety valve and a by pass line etc..
One of the key advantages of this system is its simplicity, as the characteristic properties of a side channel pump with NPSH stage guarantees safe and reliable operation.
The vapour extraction of the pump and subsequent evaporation cool down the liquid in the suction tube. The resulting pressure gradient relative to the constant tank pressure ensures that liquid in the suction tube rises to the pump level. As the liquid is pumped, a high-energy partial flow is fed back to the tank. The return of energy to the storage tank generates the differential pressure during pump operation required for the positive suction head.

1.3 Multistage centrifugal pumps ZEA / UEA up to 220 m^3/h

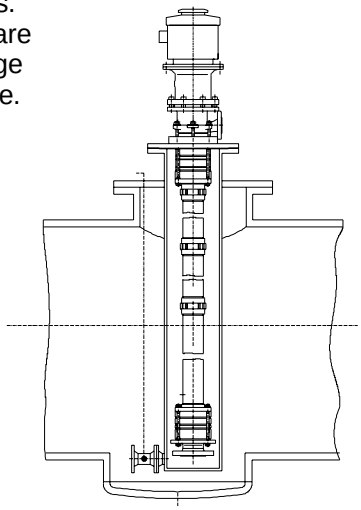


The multistage pumps have been specifically designed for the efficient transport of large flow volumes and combine one or more centrifugal stages and a NPSH inducer stage.
The axial suction position with the specially developed first NPSH stage ensures low positive suction heads for liquefied gas pumping.
As, in this application, it is often not possible to fully prevent gas collection in the intake line, the centrifugal stages can be complemented with an additional side channel stage.
Centrifugal pumps are limited as to their capacity of transporting gases, and flow separation tends to occur when the gas content of the liquid exceeds approx. 7 %.
UEA pumps are however able to handle

even greater gas contents, as the gas is removed by the side channel stage from the main pump flow ensuring continuous liquid gas flow through the system without any need for user intervention. The three hydraulic principles incorporated in this multistage centrifugal pumps thus combine all properties required for efficient LPG pumping.

1.4 Vertical tank pumps CEB / ZEB up to 100 m^3/h

Storage tanks with a diameter of less than 6 m can also be equipped with tank pumps and suitable extensions. These vertical pumps are connected to the storage tank with a dome flange. The NPSH stage is connected to the adjustable extension and lowered to the tank bottom. All pumps are leak-free and equipped with a magnetic coupling, thus fulfilling the most stringent safety and environmental protection regulations.



2.) Installation of LPG pumps

General

Correct installation of the LPG pump is crucial for long service life and reliable and safe operation.
For pump sets, the coupling guard must be in non sparking materials like brass or aluminium, coupling must be a non sparking explosion proved execution.

- Do not exceed permitted forces on pipelines specified in the operation manual.
- Special attention must be paid to the conditions at the suction side of the pump. The maximum flow of the pump is determined exclusively by the suction conditions.

Suction line:
To ensure trouble-free operation, choose a sufficiently large pipe cross-section, suitable positive suction head (NPSHA[1)]). Avoid edges and obstacles that might lead to vapour locks and keep the flow resistance as low as possible.

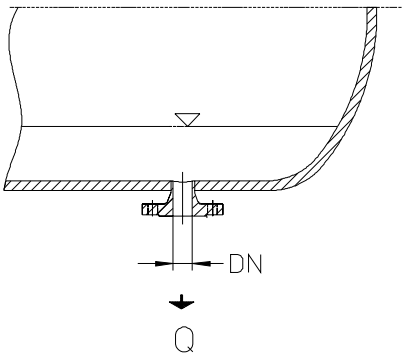
Flow rates in short suction lines of up to 10m in length should never exceed 1.5m/s. For longer lines, we recommend calculating the resistance.

NPSHA [1)] Net Positive Suction Head Available
NPSHA for LPG means the distance between liquid level above the centre line of the pump, measured on the suction flange of the pump.
Calculated it would be the distance between liquid level tank, above centre line of pump, minus total hydraulic resistance suction pipe.

NPSHA > Hz - Hv

Hz = Distance between liquid level tank above the centre line of the pump
Hv = Total hydraulic resistance suction pipe

Connection to tank:
The cross-section must be adequate for the desired flow rate. Based on our experience, we recommended the following dimension:

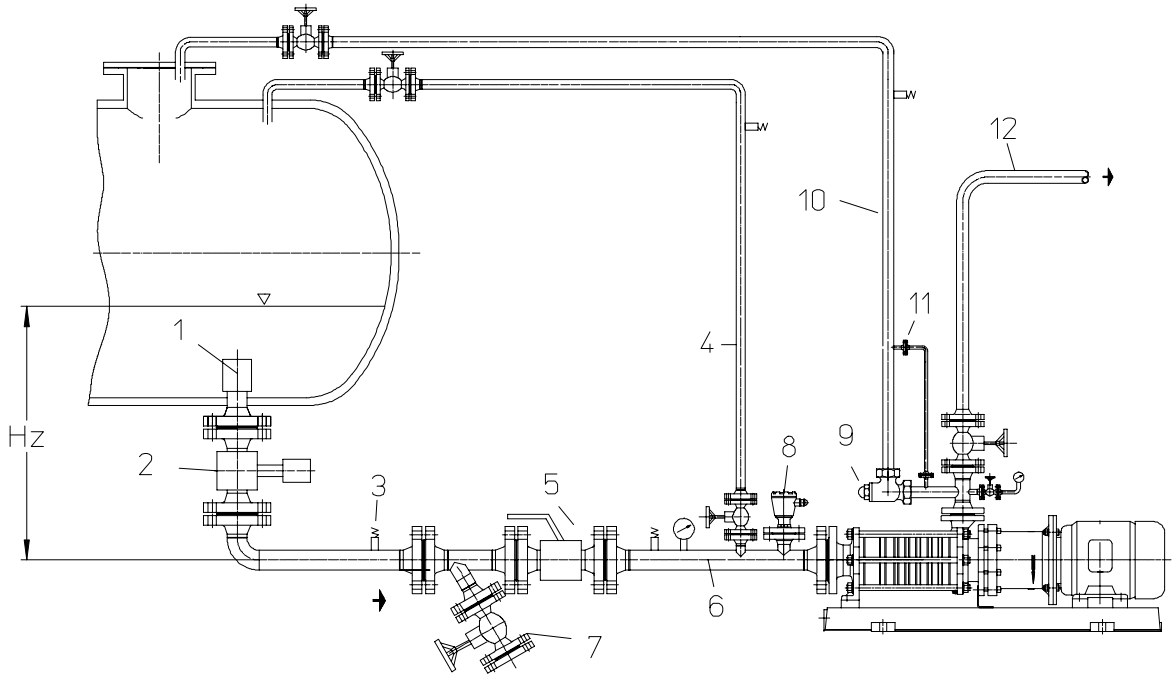


Q (m^3/h)	4	7	10	25	35
DN_{min}	25	32	40	65	80

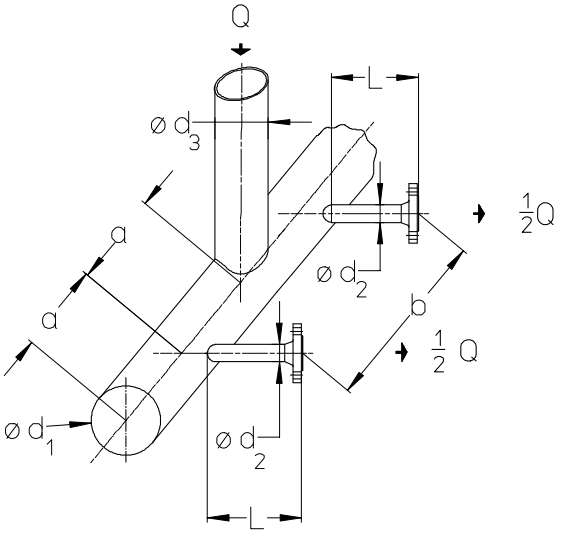
Q (m^3/h)	70	100	140	180	220
DN_{min}	100	125	150	175	200

Pipe-break safety valve (1):
If a pipe-break safety valve is required by law, choose a design that causes least flow resistance. Any additional resistance must be compensated by the vertical installation position of the tank.

Gate valves (2):
Install only ball valves and devices with similar low resistance properties.



Collective line of several pumps (header):
In systems where several pumps are connected to a common suction line, there is an increased risk of vapour locking caused by turbulence. In such a case, install a common header. For correct dimensions, please refer to the table.



CEH	DNs	d_1	d_2	L	a	d_{3min}
1200	40	125	40	300	80	65
31/3600	65	200	65	350	130	100
4100	80	250	80	400	160	125
5100	100	300	100	500	200	150
6100	100	300	100	700	200	150

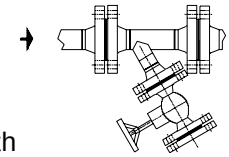
UEA/ZEA	DNs	d_1	d_2	L	a	d_{3min}
5000	100	450	100	1000	300	200
5000	125	500	125	1500	400	250
6500	125	650	125	2000	600	300
8000	150	800	150	3500	1000	400
10000	200	900	200	4000	1300	450

Filter inlet line:
In order to protect the pump and other unit parts from damage caused by dirt, we recommend installing a filter or dirt trap.

Mesh size:
Side channel pumps CEH, SC = 0.1 mm
Centrifugal pumps ZEA, UEA = 0.25 mm.

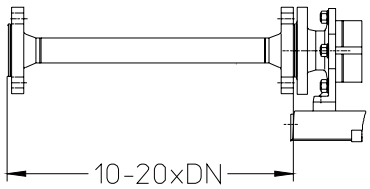
If the resulting additional flow resistance is expected to cause cavitation problems in the pump, e.g. in connection with a low tank position, and if there is no significant external contamination of the product in the feed tank, the filter cartridge can be removed after approx. 100 operating hours. Particles that entered the system during commissioning should at that stage have been removed.

Dirt trap (7):
To ensure low flow resistance, you might opt for dirt trap rather than a filter. Such a trap consists of a pipe segment with a sump. The diameter should match that of the smoothing section. The low flow rate (< 0.5m/s) allows dirt particles of a certain weight to deposit.
The sump can be easily emptied by opening the drain valve. We do not recommend using dirt traps in systems that are likely to be contaminated with low-density particles.



Safety valves (3):
Even if not required by law, we strongly recommend installing a safety valve between the two shut-off fittings. Heat from the sun can lead to expansion of the liquid so that the nominal pipeline pressure is exceeded even if the temperature is only increased by a few degrees.

Flow normalizer (6):
To achieve the guaranteed positive suction heads, we recommend installing a flow normalizer in all pumps with axial suction position.
The length should be 10 to 20 x DN. If the pump is operated at conditions that correspond to a value in the left part of the diagram (low flow), the shorter recommended length is sufficient. For pumps operated at conditions corresponding to the right part of the pump characteristic (high flow), choose the longer smoothing section.



Vapour return line (4):
In systems with poor pipeline design, vapour locks can not always be prevented. In such a case, it can be useful to remove the bubbles moving slowly through the flow normalizer. To do this, install a small T-piece with a DN25 pipe at the top end of the flow normalizer. By removing the vapour, the pump can be operated at full capacity.

Pressure line(12):

Bypass orifice (11):

In poorly installed pumps, there is a risk of serious vapour locking during prolonged standstill. This prevents proper pressure build-up when the pump is started and triggers the cavitation protection. A small bypass orifice (e.g. of 2mm diameter) ensures that the pump remains filled with liquid even when standing still.

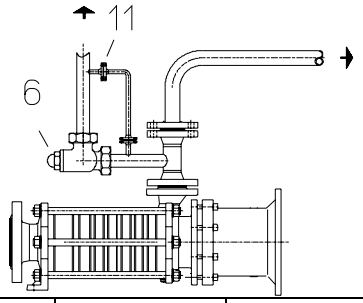
Flow loss of 2mm bypass orifice:

Q(m^3/h)	0.4	0.5	0.6	0.7
p (bar)	5	7	9	12

Under certain circumstances (e.g. suitable orifice diameter and pump capacity), the bypass orifice acts as a cost-effective minimum flow rate protection.

Bypass valve (9):
We recommend installing a bypass valve in order to ensure that the maximum pump pressure is maintained and to limit the drive performance in side channel pumps.
In order to compensate for the fluctuation in vapour pressure over the seasons, always use back pressure-regulated bypass valves. This means that the valve is opened at a set differential pressure.

Opening pressure of bypass valve:
1. Limitation of motor power:
   In side channel pumps or multi stage centrifugal pumps, the opening pressure is adjusted in such a way that the rated motor power is not reached.
2. Maximum pump output pressure:
   The valve is opened as soon as the permissible differential pressure of the pump is reached.
3. Operating pressure:
   When the normal operating pressure is exceeded
   by 0,5 to 1 bar, the valve is opened.



In general, we recommend adjusting the bypass valve values to the lowest possible level in order to relieve the pump and drive.
In pumps with extremely flat characteristics such as single-stage centrifugal pumps, the small pressure differences in the Q_{min} range might lead to problems regarding the protection of the system. In such a case, different other equipments might offer better protection. In this case for the correct equipment, the pump manufacturer should consulting.

Filter in pressure line:
As abrasion caused by wear in the pump cannot be excluded in all cases, we recommend installing an additional filter in the pressure line in all systems with components that are easily damaged by dirt particles. The mesh size depends on the permissible particle size.

3.) Control of the minimum and maximum permissible flow rate

Minimum permissible flow rate:
If the actual flow rate drops below the permissible minimum flow rate, the pump can be damaged, e.g. due to:

- Increase of NPSH value, sudden drop in pump pressure resulting in damage caused by cavitation
- Mechanical overload; differential pressure exceeding permissible limit, resulting in excessive wear
- Sudden pressure loss due to internal heating Pump is heated by friction, resulting in internal evaporation

Such effects can be prevented by installing bypass valves or sufficiently dimensioned Qmin orifices (see chapter 2). For the correct dimensioning of the orifices, always consult the manufacturer.

Maximum permissible flow rate:
The low pump counter pressure might lead to a flow rate that exceeds the maximum permissible value. As the NPSH value increases considerably, there is a risk of flow separation and vapour locking inside the pump.
The required differential pressure can be achieved by slight throttling or by installing a Q_{max} orifice. For the correct dimensioning of the orifice, consult the pump manufacturer.

4.) Safety monitoring of LPG pumps

For safety reasons, the operation of pumps with mechanical seals and magnetic couplings in explosive atmospheres is only permitted under special circumstances. To prevent dry running, the pump unit may only be operated with an adequate liquid level, and the cooling/lubrication flow in the pump must be continuously monitored to ensure that the set limit value is not exceeded.

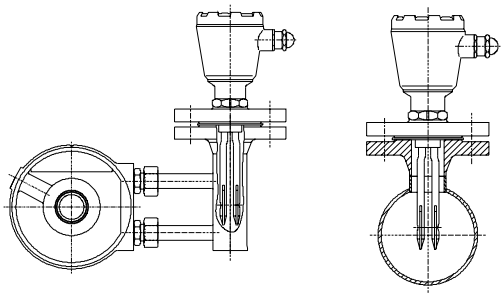
This can be achieved by a number of different monitoring options:

Mechanical seal pumps:
For pumps with single mechanical seals, cavitation protection is particularly important for two reasons:
- During proper operation, the sliding surfaces are exposed to a constant flushing and cooling flow. If this flow is interrupted, there is a serious risk of dry running damage, leading to leakage at the mechanical seal.

- Due to the vapour pressure, the high contact pressure of the sliding surfaces causes great frictional heat.
In contact with oxygen, these surfaces might become ignition sources.
In pumps with double mechanical seals, the feed system must also be constantly monitored.
Vent air the system during commissioning, as there is otherwise a serious risk of explosion.

Magnetically coupled pumps:
Cavitation can lead within minutes to overheating by several hundred degrees Celsius at the magnetic can.
In many cases, the operator has previously recorded process control data, which can be used to protect the pump from damage caused by dangerous operating conditions. By monitoring the motorcan temperature, motor flow, head or volume flow, most causes for malfunctions can be detected early, initiating automatic shut-down so that both personnel and the equipment are protected.

4.1) Liquid level monitoring FTL
LIQUIPHANT with NIVOTESTER

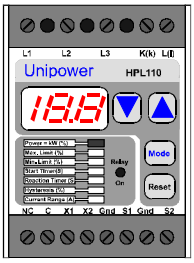


The LIQUIPHANT is a level limit switch for installation in pipelines or pump housings suitable for liquids at temperature of between -40 °C and +120 °C.

The symmetric vibrator of the LIQUIPHANT is piezoelectrically excited to its resonance frequency. The frequency changes as soon as it is immersed in liquid. The built-in green LED is on when the vibrator is not immersed. When it is completely immersed in water, the LIQUIPHANT issues a PFM signal, which is sent to the NIVOTESTER through the two-wire line.

The NIVOTESTER is equipped with a potential-free contact to shut down the drive motor. In the case of large vapour locks in the supply lines, we recommend installing a time-delay relay. Delay times between 10 and 20 seconds prevent accidental switching.
The system can be installed directly into the housing of the CEH/6 and CEH/7 models, so that the liquid level in the pump itself is monitored.
For other pump models, we recommend installing the devices in the flow normalizer. The switching point should be located in the upper part of the pipeline.
The maximum start-up delay is up to 30 sec. (max 60 sec. after permission of pump manufacture) to ensure that the pump can be started without triggering an overload signal.

4.2) HPL 110 MOTOR LOAD DETECTOR



The HPL 110 motor load detector protects the pump against dry running, overload and underload. The detector is connected directly to the power of the drive motor. It constantly measures the shaft output and thus detects any changes to the process load. This data is used to control the relay built into the detector.

Upper and lower thresholds

The load detector is equipped with three keys that are used to adjust its thresholds to the normal operating range of the unit. As soon as the output is outside the set range, the internal relays are triggered. They are equipped with changeover contacts that can be used to trigger an alarm signal and/or to shut down the pump. The load detector has a start-up delay of up to 30 sec. (max 60 sec. after permission of pump manufacture) to ensure that the pump can be started without triggering an overload signal.
First determine the normal load range and the upper and lower limit values, based on the pump curve or test measurements.

1. <u>Maximum pump output pressure:</u>
   - In side channel pumps (like CEH, SC CEB, etc.) the highest operating energy input is reached at maximum differential pressure. According to the permissible differential pressure of the pump, the limit value of the motor current is reached and the pump is shut down.

   - In centrifugal pumps (like UEA, ZEA, ZEB, , etc.), the lowest operating energy input is reached at the highest differential pressure. According to the permissible differential pressure of the pump, the actual motor current value is below the limit value and the pump is shut down.

2. <u>Maximum pump output volume:</u>
   - In side channel pumps (like CEH, SC CEB, etc.) the lowest motor current value is reached at maximum flow volume.
   According to the maximum permissible flow volume of the pump, the actual motor current value is below the limit value and the pump is shut down.

- In centrifugal pumps (like UEA, ZEA, ZEB etc.), the highest operating motor current value is reached at the highest flow volume. According to the maximum permissible flow volume of the pump, the actual motor current value is above the limit value and the pump is shut down.

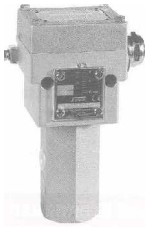
The monitoring with motor load detector operates with a slight delay to the other systems. In extreme cases, evaporation inside the pump might occur as a result of overheating, due to insufficient flow volumes or cavitation caused by excessive flow volumes. In this case, the declining pump energy input must trigger the shutdown of the motor.

Switching times: If the set value is not reached within 30 seconds (extendable to max. 60 seconds after consultation with the pump manufacturer), the drive motor must automatically be shut down.

4.3) Pressure sensor monitoring the minimum differential pressure

A very common dry running protection system is based on the monitoring of the differential pressure. As the vapour pressure changes in line with the outside temperature, all possible lead pressures must be taken into account. If, due to changing lead pressures, it is not possible to determine a precise switching point, complete a pump differential pressure measurement at two measuring points located at the suction and the discharge end of the pump.

If the differential pressure of the pump drops to a value below 50% of the normal pump pressure and above 2 bar, the motor is shut down. Check whether the switch-off point is set correctly by temporarily closing the pressure side fittings after commissioning. Due to the heat generated in the pump, the product evaporates and the pump pressure drops to zero.
Latest 30 seconds
(or 60 seconds, if required
and after consultation with the
pump manufacturer) after the
pressure drop, the drive motor
must automatically be shut down.



5.) Commissioning of LPG pumps:

For the commissioning of the unit, strictly adhere to all instructions in the operating manual and the applicable regulations for liquefied gas systems.

- Complete pressure leakage test
- Ensure that all pipes are properly connected and stress-free
- Check alignment of coupling
- Vent the hole system; open the valve behind the pump until liquid starts to escape; ensure that the system is free of oxygen
- Check direction of rotation of the motor
- After the pump has been started, check bearings and shaft seals for unexpected temperature increases
- Test dry running protection

6.) Service

LPG pumps generally should be controlled every 1.000 operating hours concerning shaft seal leaks, bearing noise and operating in right duty points. Sterling LPG pumps should only be serviced by Sterling Service Centres or authorised workshops.
For the repair or replacement of pressurised or safety-relevant components, use only original spare parts.
Prior to restarting the unit after a repair, you must complete a pressure test as laid down in the operating instructions.

7.) Standards and statutory regulations

For the processing of flammable liquids, EN ISO 5199 5.1 recommends the use of tough materials such as GGG40 or similar ductile casts.

If pumps made in grey cast iron are used in Europe for the transport of liquefied gases, Sterling as the manufacturer of the pumps rejects any liability for consequential damage.

Other applicable technical regulations and standards for LPG applications:

-ATEX, EU Directive 94/9/EC, appendix I
-TRB 801 No. 5 (German technical rules for pressure vessels)
-TRG 401 3.11 (German technical rules on compressed gases) – Installation of filling facilities

CE EC Declaration of Conformity

STERLING

The manufacturer:

S.A.S. Sterling Fluid Systems (France)
1-3, Avenue Georges Politzer
F-78190 Trappes

declares herewith that the product

Pump: CEBA

Serial number: XXX

fulfils all relevant provisions of the Directive Machinery 2006/42/EC.

Furthermore the aforementioned product complies with the provisions of the EC Directives:

- **Explosion Protection 94/9/EC (ATEX) as follows:**

Pump: Ex II 2G c T1-T5

Harmonised standards used:

EN 809
DIN EN ISO 12100-1
DIN EN ISO 12100-2
EN 1127-1
EN 13463-1
EN 13463-5

Other technical standards and specifications used:

Person authorised to compile the technical file:

Franck Godard
S.A.S. Sterling Fluid Systems (France)
1-3, Avenue Georges Politzer
F-78190 Trappes

Place, date:

XXX, XX.XX.XXXX

Person empowered to draw up this declaration:

Product Line Manager Operation Manager