AIR LIQUIDE

Air Liquide AGS GmbH

As Built Documentation

Chapter 3.4.6 Truck filling pump

- LAR Truck Filling Pump P44001 Type: CL-19/EM-7,5
  Instruction Manual for Liquid Gas Centrifugal Pump

Instruction Manual
for
Liquid Gas Centrifugal Pump

LAR Truck Filling Pump P44001

Pump - Type	:	C-19/EM-7,5
Sefco Ref. No.	:	05.042
Customer	:	Air Liquide AGS GmbH
Customer Ref. No.	:	Order. No.: 4500023387 of 11.01.2005 Project: K70101 Project name: "ASU Košice"

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ANNEX: C-19

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Parts list of accessories	No. 05.042/13
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Performance curves	No. 229-04/3
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Delivery certificate	No. 05.042/1
Test certificate for suction hose	
Test certificate for discharge hose	
Certificate of conformity E Motor	

1 Declaration by the Manufacturer

(according CE Directive 98/37/EEC, Article 4.2. and Annex II, sub B.)
Prohibition to put into service

Manufacturer : SEFCO AG

Address : Wuhrmattstrasse 15, Postfach
CH-4103 Bottmingen

Herewith declares, that

the Centrifugal Cryogenic Pump(s)

- **Type:** C-19/EM-7,5
- **Ref. No.:** 05.042
- **Tag No.:** P44001
- **Customer :** Air Liquide AGS GmbH
- **Order No.:** 4500023387 of 11.01.2005
- **Project name:** "ASU Košice"

is/are designed and manufactured according to the standards:
- EN 13275 Cryogenic vessels - Pumps for cryogenic service
- EN 809 Pumps and pump units for liquids - Common safety requirements
and is/are intended to be incorporated into machinery or to be assembled with other machinery covered by Directive 98/37/EEC, as amended;

and furthermore declares, that it is not allowed to put the machinery into service until the machinery into which it is to be incorporated or of which it is to be a component has been found and declared to be in conformity with the provisions of Directive 98/37/EEC and with national implementing legislation, i.e. as a whole, including the machinery referred to in this declaration.

This declaration becomes unvalid by modifications of original parts or by use of foreign products.

Bottmingen, May 10. 2005

G. Lachenmaier, Responsible technique

ppa

2 Introduction

This instruction manual is based on a long theoretical and practical experience of SEFCO AG. It is helpful to the operating personnel to get familiar with the installation and operation of the delivered machines and components. Moreover, it points to possible dangers in connection with the use of these machines, and the means to avoid them. This manual must all time be available at the operating place of the machine.

Evidently, this instruction manual cannot cover all possible installation and operation conditions with the associated security precautions. In case of doubt, please consult SEFCO for further advice and guidance.

It is recommended by SEFCO that the owner/plant operator gives a profound training to his personnel according to the instruction manual; at the same time he makes sure, that the given instructions are understood and will be observed. Additional training at SEFCO is recommended.

It is expected that these machines/components will be operated exclusively by responsible and trustworthy professionals.

The responsibility of the owner/operator for installation, operation and safety (also in case of fire) will by no means be diminished through this instruction manual or a training at SEFCO.

In all cases the owner/operator is obliged to observe the current laws, regulations, instructions and recommendations.

In case of resale, modifications and/or alterations of the machine/installation, the information in the manual will have only limited validity; therefore a consultation of SEFCO is strongly recommended.

Spare parts must correspond with the technical requirements defined by SEFCO. This is guaranteed by original spare parts due to on-going quality systems. The use of spare parts of another origin can be a risk for safety. Spare parts of another origin can possibly change the features of the installation defined by design and cause significant defects and risks, SEFCO is not responsible for.
If for a product like electric motors a specific operation manual is attached to this manual it is relevant.

This manual was put together with greatest care. If you still need more information please contact:

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Switzerland

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3 Safety

3.1 Notes and symbols

The dangers are classified into several grades. The following list shows a summary of symbols, grades of danger, signal words for dangers and possible consequences.

Symbol	Damage for...	Signal word	Definition	Consequences are...
	Persons	**DANGER!**	Immediately threatening danger	Death or heavy injuries
	Persons	**DANGER!**	Immediately threatening danger by voltage	Death or heavy injuries
	Persons	**WARNING!**	Possibly dangerous situation	Possible middle to light injuries
	Goods	**CAUTION!**	Possibly dangerous situation	Possible damage to - product - its surrounding
		Note! Information! Recommendation!	Notes for application or other useful informations and recommendations	efficient operation

3.2 General notes about dangers

Observe local regulations for accident prevention with all kind of work at liquid gas centrifugal pumps!

DANGERS!

- Cryogenic fluids:

Cryogenic fluids cause blisters in case of contact with the skin. Always wear appropriate protective clothes and glasses. Touching extremely cold subjects with bare hands one gets stuck. Always wear suitable gloves!

- Liquid oxygen:

For transferring liquid oxygen, **pumps made of stainless steel are not allowed!** By handling liquid oxygen **danger of fire** may exist. All parts coming in contact with liquid oxygen **have to be free of oil and grease**. This also applies to workshops, spare parts as well as tools in use and hands ! Attention with oxygen saturated clothing! The increased concentration of oxygen in clothing can be stable over a longer period and is therefore a significant risk of fire together with possible sources of ignition like cigarettes a.o.

- Liquid hydrocarbon:

By handling liquid hydrocarbons exists the danger of explosion! Observe the relevant regulations; only use non sparking tools.

- Works at pump:

For all works at the pump make sure that the driving motor is standing still and a start up can be excluded under all circumstances! Start working only when the pump is no longer pressure containing and has warmed up to ambient temperature (to avoid ice formation by humidity)

- Sprinkling liquid:

Make sure that sprinkling liquid (leaking seals) doesn't come in contact with persons! Wear protective clothes and glasses! There is danger of burning the skin.

3.3 Important notes for operation

CAUTION!

- Operational data's:

On the pump's data sheet of this manual (§ 6) the specific operational data's are listed. These data's describe an admissible range of operation for the pump. Operating outside of this range needs the approval by SEFCO!

- Parallel Operation:

To secure an optimum operation, the following points have to be observed:

- stable pump performance curve
- separated suction lines
- pumps of the same type
- consultation of SEFCO

- Series Operation:

Only after consultation of SEFCO!

4 Machinery description

4.1 Pump

The machinery-design suits the heavy duty industrial requirements and is characterised as following:

- Centrifugal pump, directly driven by electric motor.
- Support between motor and pump
- Centrifugal pump cold-end which consists of the casing, mechanical seal, safety-,rotating- and performance components.
- Purge-gas connections at pump rear casing, standardwise built in.
- The rotating parts are carefully balanced. The critical clearances between impeller and casing are kept large (simple assembling, secure operation).

Material used

Cold-End : - all pump parts are of bronze-alloy
(Cu-content > 80 %), required for oxygen operation.
- bronze nickeled available.
- mechanical seal and screwing are stainless-steel.

Support : - stainless-steel

Pump shaft : - stainless-steel

5 Additional Subsystems

The following subsystems can be provided on customer special demand. Appropriate connections are available on the machinery unit.

5.1 Cold End

- Purge gas subsystem, with leak-gas lead-off after the seal.
- The penetration of humidity is avoided by feeding gaseous (approx. 0,5 - 1 Nm3/h), dry nitrogen (<2ppm); see also sectional drawing and spare parts list.

5.2 Additional Control-Subsystems

- Motor-monitoring-system:
  - Temperature control of winding by means of built-in PTC- sensors, alternative by RTD's (PT 100)
  - Temperature control of bearings by means of built-in PTC- sensors, alternative by RTD's (PT 100)
- Delivery-pressure monitoring-system:
  Machine shut down at a pressure falling below a set limit (pressure drop caused by cavitation), or at rising above a set limit (e.g. VFD operation)
- Other subsystems on customer request.

6 Machinery and Subsystems Data

6.1 Machinery Data

Fluid	:	LAR
Density (kg/l)	:	1.369

Pump / Gearbox

Pump-Type	:	C-19
Material/Cold-End	:	bronze
Material/Impeller	:	bronze
Number of Stages	:	1
Impeller Standard ∅ (mm)	:	190/6,5
Impeller Effective ∅ (mm)	:	165
Impeller Rotating Speed (min^{-1})	:	approx. 2920
Differential Head Δ H (m)	:	30
Differential Pressure Δ p (bar)	:	4
Flowrate (lit/min.)	:	400
Required NPSH (m)	:	0,6
Gearbox-Type	:	-
Lubricant	:	-

Electric Motor

Manufacture	:	Theo Halter GmbH
Type	:	DDA 132 SB2
Frame Size	:	132S
Design-Form	:	IMB 34
Rated Power (kW)	:	7,5
Rated current (A)	:	13,8
Rated Frequency (Field weakening point) - (Hz)	:	50
Rated Rotating Speed (min^{-1})	:	2860 / max. admissible:
Protection / Insulation Class	:	IP55 / F used B
Max. ambient temperature / installation altitude (°C /m above sea level)	:	40 / 1000
Δ - Voltage / Frequency / Phases (V / Hz)	:	400 / 50 / 3

Variable Frequency Drive (VFD)

Manufacture	:	-
Type	:	-
Protection	:	-
Ambient Temperature (°C)	:	0 - 40
Mains Voltage / Frequency / Phases (V / Hz)	:	-
Rated output Current (A)	:	-
Field weakening point (Hz)	:	-
Max. output Frequency (Hz)	:	-
Max. Cable Length to the Motor (m)	:	-

6.2 Additional Subsystems and Components

- Suction strainer DN65
- Flexible suction hose DN65 PN6
- Flexible discharge hose DN40 PN40
- Seal leakage detection RTD's
- Purge gas regulation device

7 Pump preparation

7.1 Before delivery

- Hydrostatic pressure test of cold-end casing at 1.5 times the maximum admissible discharge pressure of the pump.
- Thorough mechanical checkouts
- Standardwise degreased for oxygen operation (independent of pumped liquid and application)
- Cold-test with liquid nitrogen

7.2 On arrival at customer site

- Check for transportation damage

CAUTION!

If unit is not put immediately into operation:

„STORE IN DRY AND CLEAN ROOM"
protected from oil, dust and moisture

Keep material sealed/packed until required for use!

7.3 Handling

- Prepare suitable tools and hoists. Pay attention to the weight!

WARNING!

- Too poor dimensioned or damaged lifting equipment could tear!
- Always check the lifting equipment for correct size and faultless condition!
- Take care that no built up equipment is damaged by lifting

8 Pump installation

See installation-schematic No. E10200-1

8.1 Correct suction-line:

NOTE!

- **short** and well **insulated**.
- **simple** and **straight** ducting, without narrow bends and sudden section-changes.
- **continuous down-flow** towards pump, **no gas accumulation on suction side**.
- **optimum section** to minimise pressure-loss and heat-input.

Attention on errors!

- Narrow bends and sudden section-changes = higher pressure-loss.
- Long, narrow and poorly-insulated pipe = higher pressure-loss and heat-input.

CAUTION!

Higher pressure-loss and heat-input
↓
„Poor NPSH (§ 9)“
↓
Low suction performance, gas-formation, cavitation
↓
Poor pump performance, pressure-fluctuation, pump vibration
↓
„Pump and seal damage“

WARNING!

- Installation of a **strainer**, especially for oxygen operation!
  foreign particles may damage the pump and could cause fire or explosion.
- Installation of a **safety-valve** between main closing-valve up-stream and pump inlet (set about 1,5 bar above operational suction pressure), to avoid inadmissible pressure build-up.

8.2 Piping system and components:

We recommend a piping-system according to schematic No. E10200-1.

CAUTION!

„Piping forces on the pump casing have to be kept at a minimum“
(see list „Maximum nozzle loading“)

NOTE!

Suction- and pressure pipes should be straightened and adjusted!
Take care of pipe-shortening due to cold (contraction).
Accordingly install **„Fix points“** and use **„Flexible Pipes“** on the pump suction- and pressure side.

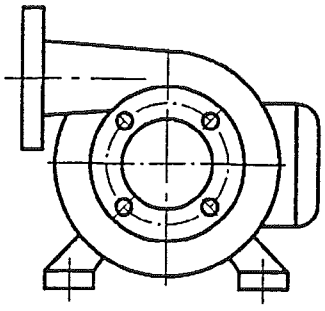
It is recommended to finally fix the holding down bolts of the machine only in cooled down condition.

Minimise flow disturbances at pump-inlet.

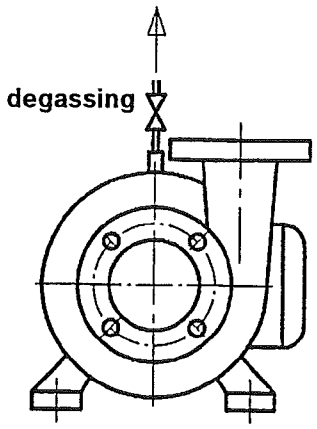
NOTE!

Flange- position on delivery side: (only for horizontal pumps)

In order to cool and degas the pump optimally, the following flange positions should be applied



optimum
(for correct piping)



Only permitted with built-in device for degassing

For other flange positions refer to SEFCO first

NOTE!

Piping system:

Schematic E10200-1 illustrates the typical installation (piping and components) for a centrifugal pump unit. The required and recommended components are indicated there.

8.3 Pump protection

RECOMMENDATION!

- In every case: put a cover over the pump to protect it against dripping water. Splashing the pump with water has to be avoided.
- At fixed installation: Purge the sealing chamber with dry (< 2ppm) nitrogen-gas to avoid moisture penetration; the appropriate connections are available on the pump rear casing. Feed will be connected to the upper union on the pump rear casing. The lower connection union will be kept open. Feed pressure ≤ 0,1 barg. Such purging is also beneficial on a mobile unit.

8.4 Electric connections

DANGER!

These works are to be carried out only by authorised professionals.

The motor connections are to be installed according to the information on the motor plate as well as schematic E 10669. For differing installations the schematics in the annex are valid.

CAUTION!

For VFD operated motors, make sure not to exceed the maximum admissible speed of the pump or the motor!

9 Suction pressure - NPSH required

For secure start up and running of the pump, a minimum suction pressure is required (according to design, flow rate and rpm).

Liquid gases have an equilibrium pressure, usually close to the vaporisation pressure p_D Thus, a static pressure p_S greater than p_D is necessary at the pump inlet, to **avoid or minimise vaporisation and gas-formation** at a critical point of the pump.

This critical point of a centrifugal pump is commonly the leading edge of the impeller blade, where the flow is accelerated to the maximum relative velocity. Local stall will lead to even higher velocity, causing a **minimum static pressure** p_{crit} at the blade leading edge, which should **not be smaller** than the local **liquid vaporisation-pressure** p_D.

Hence, with respect to the fluid mechanics entering the pump (losses, acceleration), a static pressure p_S at the suction flange is required such that the following condition at the pump critical point is satisfied:

CAUTION!

$p_S > p_{crit} > p_D$ (p_D at critical point of the pump)

If this condition is not met, gas-formation and cavitation will occur in the impeller: the flow will stall, causing pressure-drop, vibration and pump damage.

The „NPSH"

The NPSH (**Net Positive Suction Head)** expresses the required pressure difference (p_S - p_D) above vaporisation pressure p_D at the pump suction flange. This pressure difference being divided by the liquid specific weight γ_S at suction flange, gives:

$$NPSH = \frac{p_S - p_D}{\gamma_S} = Liquid - Height$$

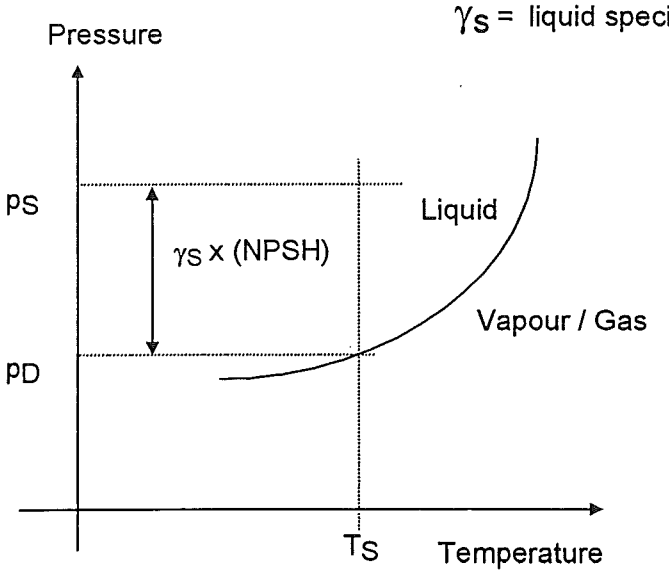
CAUTION!

For secure start-up and running of the pump, the **NPSH must be such, that p_{crit} is greater than p_D** at the pump critical point!

The NPSH is always given in „metres" at the pump suction flange

The following figure represents the NPSH in the vapour-pressure curve:

p_S = static pressure at suction flange
p_D = local vapour-pressure = f (T)
T_S = effektive flow temperature at suction flange
γ_S = liquid specific weight at suction flange = f (T_S)



According to performance and design, the machinery manufacturer determines experimentally the required NPSH for each pump type:

NPSH = f (flow rate, rpm)

NOTE!

To improve the NPSH:

- Increase the flow suction head.
- Increase the tank pressure (only efficient for a short time, as temperature will adapt again to the pressure level).
- Subcool the liquid (decrease vapour-pressure)
- Insulate the suction pipe and minimise pressure losses well
- Add an inducer (axial impeller) to increase the flow static pressure at the radial impeller leading-edge

10 Pump Operation Start-Up

10.1 Before start-up

NOTE!

- **Rotate** machine by hand, acting on motor fan-blade or slinger-disc, to check the shaft for free rotating.
- **Check rotational sense** (only on **cooled-down pump**) for correct electric-motor connection as following:

  Short electric motor start. The observer stands behind the motor looking in direction cold-end: the fan-blade and the pump- impeller must rotate in clockwise direction (observe also slinger-disc).

10.2 Operation start-up (see schematic No. E10200-1)

CAUTION!

Pump should not run dry, otherwise seal will be damaged!

10.2.1 Cool-down of the pump (cold-end)

WARNING!

Observe chapter 3 „ Safety " when operating the pump.

- Open bypass-valve **10**, fully open Suction-valve **1**.
- Valve **7** and **8** closed
- Actuate pressure build-up system (if available), in case of low suction pressure (NPSH, see § 9): open valve **11** for a short or longer time and observe pressure build-up on pressure gauge **4**.
- Observe frost formation on cold-end casing.
- Pump is sufficient cooled down for start-up, once the cold-end casing is covered with frost and is completely degassed; Check by short opening of degassing-valve **8**.
- Slightly throttle bypass-valve **10** and start-up motor! After a short delay the pump will come to operation and reach operating pressure. Control the by-pass valve **10** accordingly so that the maximum admissible performance of the electric motor according to the design-flowrate is not exceeded.

CAUTION!

- Do never fully open the bypass valve **10**, as there is low counter-pressure downstream. Valve **10** must act as a throttle-valve!

  At fully open valve **10**, the flowrate and hence the electric power largely exceed allowable values: the electrical overload protection should immediately shut-down the power supply, otherwise the pump through-flow will stall, causing dangerous cavitation and vibrations!
- Should the pump not come to operation pressure at first start-up, stop motor immediately, cool-down and degas the pump further (2-3 minutes), then start-up again.

CAUTION!

At **excessive** cool-down (frost covering support), **do not start-up pump**, shaft could be blocked by **shrunked bearings**:

Check the shaft for free rotation, acting by hand on slinger-disc (with gloves!). If it is rotating freely, the pump can still be started, otherwise the cold-end has to be warmed up.

10.2.2 Operation of the pump

- Close slowly bypass valve **10** and open progressively valve **7** to consumer.
- Bypass valve **10** completely closed.
- Adjust valve **7** to meet design-pressure **9** and flowrate: a reference value is the flow measurement or the electric motor power consumption, which can be controlled with an amperemeter.

CAUTION!

Do not use suction valve 1 for regulation purpose! A reduction of the suction pressure could cause cavitation (bad NPSH!)

Fluctuations in pressure and flow (pulsations) as well as impacts of liquids lead to an increased and uncontrollable load on the bearings as well as to an extreme stress for the mechanical seal- and driving parts.

10.2.3 Stop of the pump

- Cut off electric current to motor.
- Open bypass valve **10**, close valves **7** and **1**.
- Use valve **12** to release tank pressure.
- Close valve **10**. Release pipe pressure with valve **8**.

10.3 Operation disturbances

WARNING!

Observe chapter 3 „ Safety " when operating the pump.

Disturbance	Possible reason	Correction pump *not operating*
Pump does not perform (Pressure and Flowrate)	Wrong direction of rotation Insufficient suction pressure Gas formation Suction filter blocked	Reverse motor pole connection Raise tank pressure Cool-down/degas pump well Clean suction filter
Pressure and Flowrate too low	Gas-liquid mixture (bad NPSH) Suction filter blocked Impeller- Labyrinth-clearance excessive Impeller damaged Inducer damaged	Check suction piping (see § 8.1) Raise tank pressure Clean suction filter Replace wear-rings Replace impeller Replace inducer
Power consumption too high	Electrical defects	Check electrical system
Pump vibration	Gas-liquid mixture / cavitation (flowrate too high or low) Unbalance caused by damaged impeller, inducer or shaft	Check suction-piping (increase required NPSH) Replace damaged parts or possibly re-balance. (SEFCO)
Unusual noises	Motor bearings damage Bad motor bearings lubrication Unbalance External tubing forces too high for the pump casing	Replace bearings Regrease or replace life greased bearings Replace impeller or inducer or possibly re-balance (SEFCO) Check fix points Exactly align pump and tubing (see § 8.2)
Pump leaks	Mechanical seal damaged	Check/replace mechanical seal

Operation disturbances (continuing)

Disturbance	Possible reason	Correction pump *not operating*
Unusual bearing temperature	Motor bearings damage Bad motor bearings lubrication	Replace bearings Regrease or replace life greased bearings

Disturbance	Possible reason	Correction pump *operating*
Power consumption too high	Max. flowrate exceeded	Reduce flowrate
Pump vibration	Gas-liquid mixture / cavitation (flowrate too high or low)	Check suction-piping (increase required NPSH) Adjust flowrate
Pressure and Flowrate too low	Low rotation speed	Check rotation speed
Unusual noises	Flowrate too high or low	Adjust flowrate

11 Overhaul and maintenance

Repair and service must only be done by **qualified** and **especially trained** personnel.. Such training can be provided at SEFCO.

11.1 General requirements

at leakage of the mechanical seal or other disturbances:

- Dismantle the pump
- Clean all parts and degrease carefully for oxygen operation
- Check and replace all worn-out parts
- Inspection of the electric motor:
  - Check the condition of the bearings
  - Check the insulation resistance

11.2 Lubrication

CAUTION!

- Motors without regreasing device are life greased and don't need any servicing. (Recommendation: preventive bearing change approximately every 20.000 operating hours).
- Motors with regreasing device: Intervals, grease amount and grease type according to specific tagging on the motor.
- Do not grease during standstill or at rotational speeds above 3500 rpm.
- Electric motor bearing grease: Klüber Isoflex Alltime SL2

11.3 Repairs and Spare parts

It is most recommended to hold spare parts stored:
Fast replacement / repairs without delay (see spare-parts list).

Indicate on spare-parts order:

- **Pump type**
- **Customer-Ref. No.**
- **Sefco Ref.-No.**
- **Part name and position** (according to spare parts list)

For larger repairs and complete overhaul, we recommend to send the machine to SEFCO. (for planning purposes and shipping formalities, please contact SEFCO first).

12 Pump Disassembling (Drawing No. 2 12200)

DANGER!

Observe chapter 3 " Safety " when working at the pump.

- The machine is electrically dead and checked for de-energizing. All tubing is at ambient temperature and not pressurized).
- Remove suction- and pressure pipe.
- Put **Pump/Motor** unit in vertical position, with motor below.
  (for motors with frame size ≥ 250 dismantle first fan and fan hood)
- Remove hex. nuts **41**, washers **40** and pull off pump casing **36**.
- Remove screws **38** and wear ring **37** from pump casing only if necessary to change.
  (using take-off device)
- Remove flattened seal-cord **42**.(Casing seal)
- Remove circlips **47**, screws **44**, washers **45** and **46** only if diffusor **43** has to be changed.
- Remove circlip **35**, safety screw **34**, screw **33** and strain washers **32** and draw-off impeller cap **29** or inducer **30**.
- Draw-off impeller **27** with keys **28** from shaft.
- Draw-off rotating seal-ring **26** and shims **25**.
- Remove screws **22**, washers **23**, **24**, mechanical seal **18** and seal-washer **21**.
- Remove screws **13**, washers **12** and rear-casing **8** from support **2**, (observe position).
  Remove labyrinth outer bushing **11** only if necessary to change.
- Remove screws **10** and wear-ring **9** from rear-casing only if necessary to change.
  (using take-off device)
- Remove insulation-ring **7**, draw-off labyrinth shaft-bushing **17** and labyrinth-bushing **16** from shaft.
- Remove screws **6** and dismount slinger disc **5**.

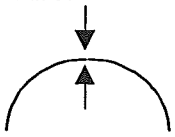
  If support 2 should be dismounted, mark its position to motor-shield before removal; same condition applies for motor-shield as to motor.
- Remove screws **4**, washers **3** and dismount support **2**.

13 Pump Assembling (Drawing No. 2 12200 and Checklist No. 4 12817)

DANGER!

Observe chapter 3 „ Safety " when working at the pump.

- **Prior to assembling, all parts must be carefully degreased** and checked for damages. **Spare parts shall remain originally packed until they are used.**
- **Do not use lubricants to assemble.**
- Running tolerance of shaft end: 0,04 mm
- Mount support **2** on motor-flange. (observe position)
- Mount slinger-disc **5**. (align screws to flattened areas)
- Place labyrinth-bushing **16** and labyrinth shaft-bushing **17** on shaft.
- Mount wear-ring **9** in rear-casing **8** and **37** in pump casing **36** and secure with screws **10 / 38**. Slightly hammer screw-thread to secure.
- Mount diffusor **43:**
  Observe position according to sketch, secure screws **44** with circlips **47**.



- Press labyrinth outer-bushing **11** in rear-casing **8**.
- Place insulation-ring **7** and rear-casing **8** in support **2** and fasten with screws **13**. (observe position)
- Place softened seal-washer **21** in rear-casing **8**.
- Place mechanical seal **18** in lead-bushing **19** and check **pretension of approx. 1 mm**, then adjust mechanical seal concentrically and fix with screws **20**.
- Mount lead-bushing together with mechanical seal in rear casing **8**.
- Place shims **25** and rotating seal-ring **26** on shaft. (The rotating seal-ring must move easily on shaft!).

CAUTION!

Pretension of mechanical seal :
The mechanical seal **18** must be prestressed through the rotating seal-ring **26** of

2,3 to 2,6 mm

- **Measuring procedure:** (see checklist no. 4 12817 § C)

1. Move rotating-ring **26** on shaft until touching the PTFE compound ring of the mechanical-seal:
   Measure distance from rotating-ring to shaft-end : measurement ①
2. Press rotating-ring **26** against shim **25** firmly:
   Measure distance from seal-ring to shaft-end : measurement ②
3. ② - ① = pretension
4. Adjust required pretension through peeling of shim **25**:
   This shim consists of sheet-metal layers (0,05 mm thickness), which can be peeled off each with a sharp knife.
5. Check if pretension is correct.

- Mount impeller **27**, place both keys **28**, mount impeller-cap **29** or inducer **30** and tighten with screw **33** at approx. 38 Nm. Secure with screw **34** and circlip **35**.
- Put self-adhesive seal-cord **42** on seal-face of pump-casing **36**, end overlapped.
- Mount pump-casing **36** and tighten uniformly.

CAUTION!

During the whole tightening process, check shaft for free rotation.

Same control of free-rotating after pump installation and before motor-start

		Gezeichnet Dessiné	Geprüft Controlé
	07.02.2000	NS.	
1	26.02.2002	NS	

Gezeichnet Dessiné	Geprüft Controlé

LIQUID GAS CENTRIFUGAL PUMP
Type : C - 19

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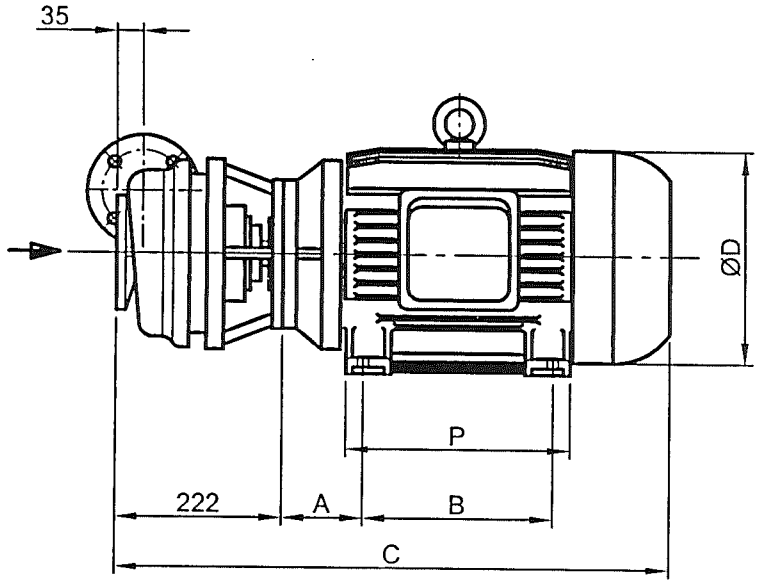
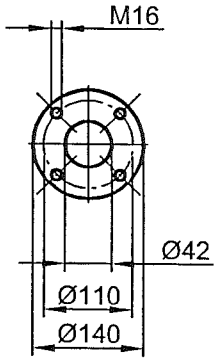
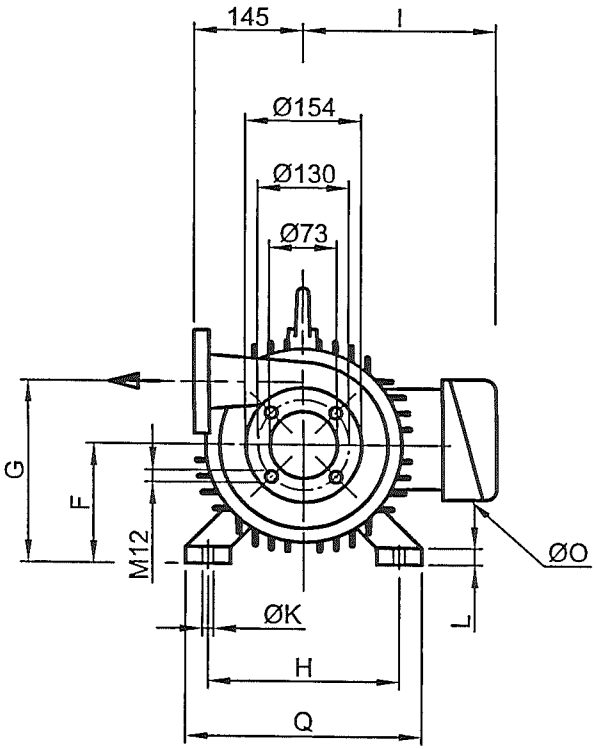






" External forces according to drawing 4 13576 "

Subject to change

Dimensions in mm

180M		121	241	796	350		180	264	279	280	~15	~25			2 x M40 x 1.5	~300	~345
160M		108	210	740	310		160	244	254	245	~15	~25			2 x M40 x 1.5	~255	~310
132S		89	140	600	260		132	216	216	213	~12	~18			2 x M32 x 1.5	~185	~266
112M		70	140	551	220		112	196	190	191	~12	~16			2 x M25 x 1.5	~176	~230
Motor type	**kW**	**A**	**B**	**C**	**D**	**E**	**F**	**G**	**H**	**I**	**K**	**L**	**M**	**N**	**O**	**P**	**Q**

4 12189

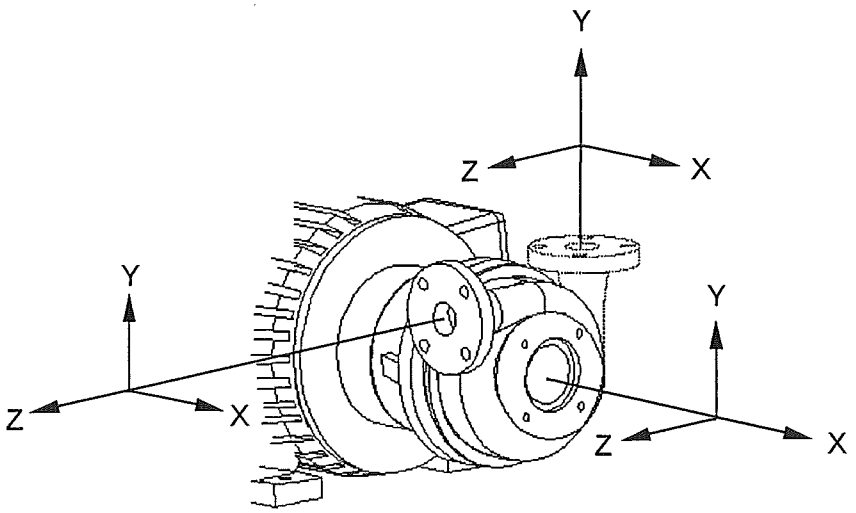
Maximale Flanschbelastungen / Kräfte- Momente

Max. Nozzle Loadings / Forces- Moments

Efforts max. aux brides / Forces- Moments

Pumpen-Typ :
Pump- Type :
Pompe- Type :

C-19, C-19/G2, C-19/PA, CL-19



		Saugflansch Suction nozzle Bride d'aspiration	Druckflansch vertikal Top discharge nozzle Bride de refoulement verticale	Druckflansch horiz. Side discharge nozzle Bride de refoulement horizontale
Kräfte Forces ***[N]***	F_x	330	170	170
	F_y	270	130	190
	F_z	220	190	130
	F_r	480	280	280
Moments ***[Nm]***	M_x	210	120	120
	M_y	105	60	60
	M_z	160	85	85
	M_r	285	160	160

r = Resultierende, Resultant, Résultante

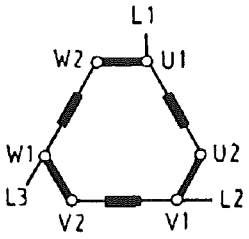
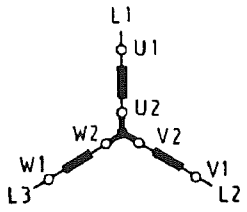
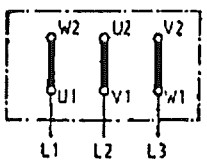
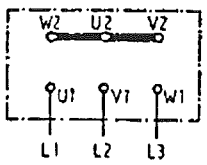
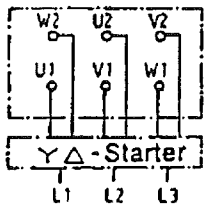
Connection for squirrel cage induction motors

Squirrel-cage induction motors are connected to the three-phase conductors L1, L2, L3. The rated voltage of the motor in the running connection must agree with the phase-to-phase voltage of the supply system.

Single speed motors:
For direct on-line starting, the running connection of the motor may be the star connection or delta connection. (For star/delta starting, the running connection must be the delta connection).

Motor winding arranged for	Supply voltage V	Running connection	
		Direct on-line starting in	Y / Δ-starting
230 Δ / 400 Y	230 400	230 Δ 400 Y	230 Δ not possible
400 Y 400 Δ	400	400 Y 400 Δ	not possible 400 Δ
500 Y 500 Δ	500	500 Y 500 Δ	not possible 500 Δ
400 Δ / 690 Y	400 690	400 Δ 690 Y	400 Δ not possible
690 Y 690 Δ	690	690 Y 690 Δ	not possible 690 Δ

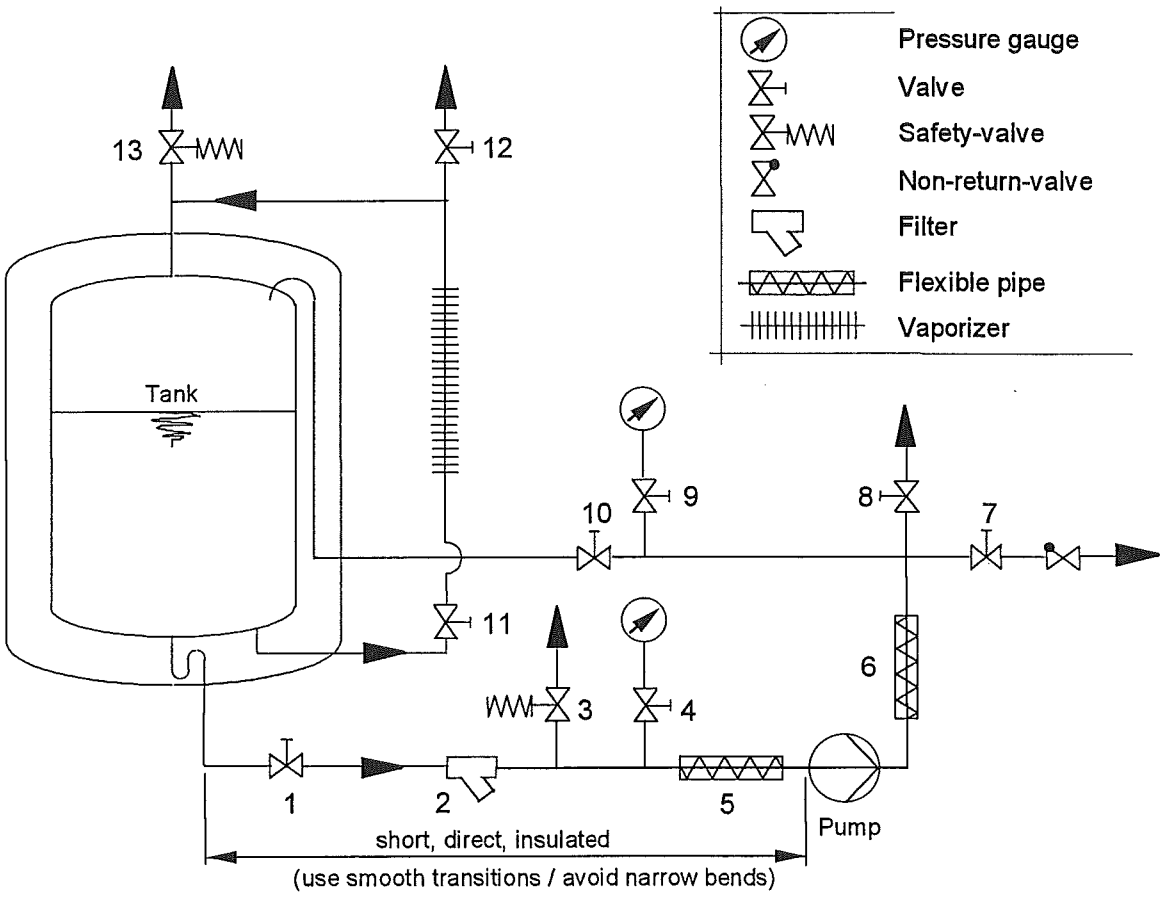
The connection of links and lines on the terminal board are dependant of the rated voltage and winding phase; e.g. for a squirrel cage induction motor with winding phase for 230 V Δ / 400 V Y with one speed the following connections must be done:

	Running connection		
	Direct-on-line starting in		Y Δ - starting
	230 V	400 V	230 V
Connection of the winding phases			The ends of the 3 windings are connected to the Y-Δ starter
Connection of links and lines	 Δ-connection	 Y-connection	

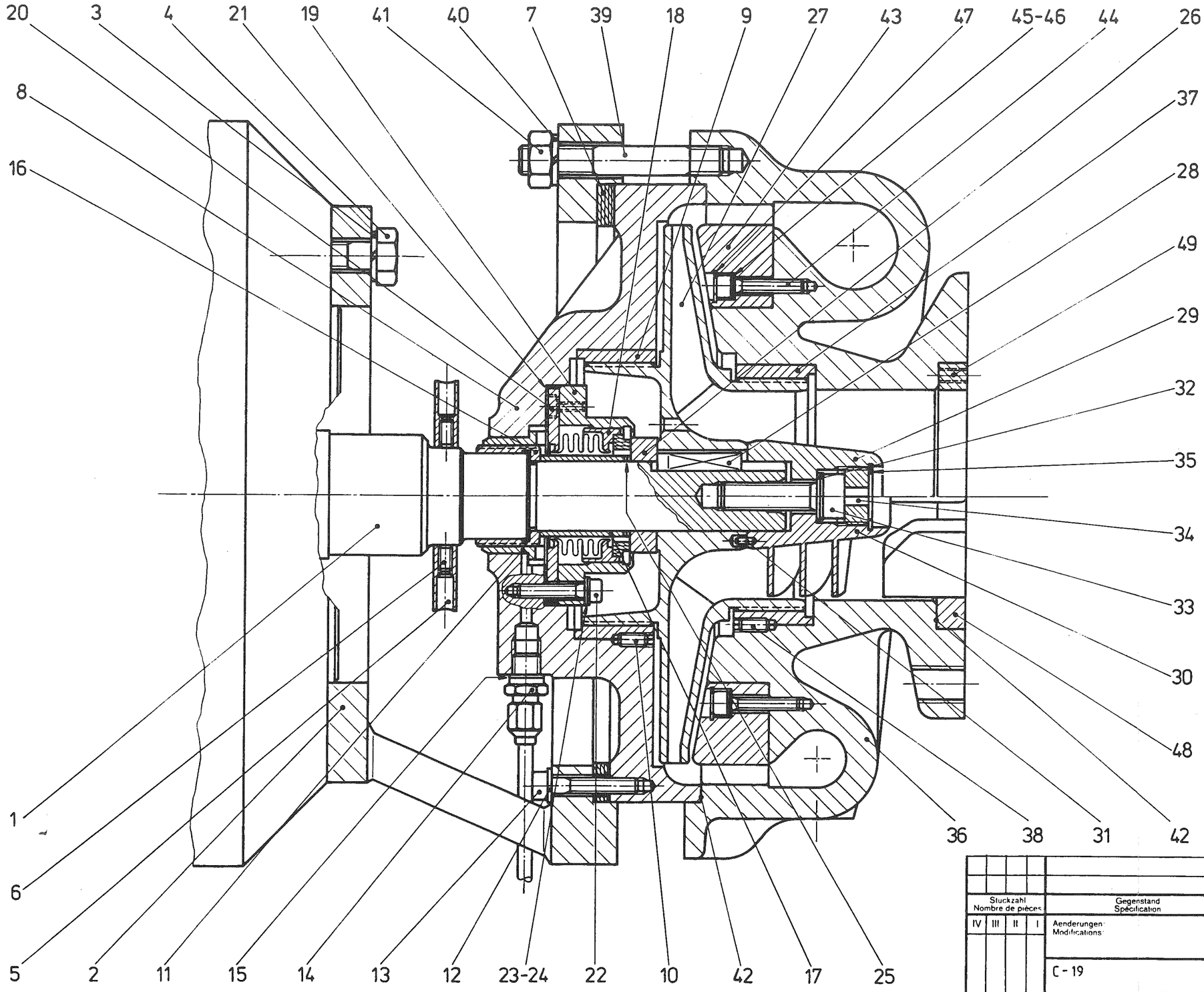
Instead of star-delta-starter preferably an electric soft-starter can be used.

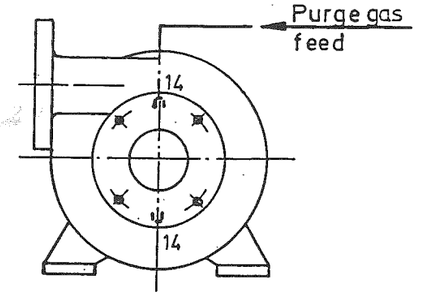
Installation schematic for centrifugal pump

The present schematic illustrates a typical system-installation for liquid-gas centrifugal pump operation, and can be extended according to needs. Accessories should at this stage be reduced to a minimum.



Pos.	Designation	Required	Recommended
1	Suction-Valve	X	
2	Filter	X	
3	Safety-Valve (Suction line)	X	
4	Pressure gauge (Suction line)		X
5	Flexible Pipe (Suction line)	X	
6	Flexible Pipe (Discharge line)	X	
7	Pressure- and Non-return-valve (to consumer)	X	
8	Degassing-Valve (Discharge line)	X	
9	Pressure gauge (Discharge line)		X
10	Bypass-Valve	X	
11	Pressure build-up System (Tank)		X
12	Degassing-Valve (Tank)	X	
13	Safety-Valve (Tank)	X	





Stückzahl Nombre de pièces				Gegenstand Spécification	Pos. Rep.	Werkstoff Matière		Modell Modèle	Bemerkungen Observations
IV	III	II	I						

Aenderungen: Modifications:

Ersetzt durch: Remplacé par:

Ersatz für: Remplace:

C-19

Kaltes Ende (Cold end)

Maßstab Echelle

Gezeichnet Dessiné	9.7.92	HR
Geprüft Contrôlé		
Gesehen Vu		

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2 12200

C-19, Drawing: 2 12200 **Cold End**

Item-No.	Parts Per Unit	Required Spare Parts	Recommended Spare Parts	Nomenclature	Material
1	1			Motorshaft end	
2	1			Support	
3	4			Strain washer M10	
4	4			Hex. cap screw M10 x 35	
5	1			Slinger disc	
6	2			Socket set screw M5 x 10	
7	1			Insulation ring	
8	1			Rear casing	
9	1	1	1	Wear ring	
10	2			Socket set screw M5 x 10	
11	1		1	Labyrinth outer-bushing	
12	4			Washer M5	
13	4			Socket head cap screw M5 x 30	
14	2			Fitting	
15	2			Seal washer ∅ 13,5 x 10 x 1	
16	1		1	Labyrinth bushing	
17	1		1	Shaft bushing	
18	1	1	1	Mechanical seal	
19	1	1	1	Lead bushing	
20	4			Socket head cap screw M4 x 10	
21	1	1	3	Seal washer ∅ 75 x 48 x 0,2	
22	8			Socket head cap screw M5 x 25	
23	8			Washer M5	
24	8			Strain washer M5	
25	5	1	1	Shim ∅ 30 x 24 x 1	
26	1	1	2	Rotating-ring	
27	1			Impeller	
28	2			Key C8 x 6 x 30	
29	1			Impeller cap (Inducer Pos. 30 as alternative)	
30	1			Inducer (Impeller cap Pos. 29 as alternative)	
31	2			Spring tension pin ∅ 3 x 8	
32	2			Strain washer M10	

Rev:	Date:
0	2.10.2000

C-19, Drawing: 2 12200 Cold End

Item-No.	Parts Per Unit	Required Spare Parts	Recommended Spare Parts	Nomenclature	Material
33	1			Socket head cap screw M10 x 35	
34	1			Safety screw M20 x 1	
35	1			Circlip ∅ 20 x 1	
36	1			Pump casing	
37	1	1	1	Wear-ring	
38	2			Socket set-screw M5 x 10	
39	12			Stud M10 x 60	
40	12			Split lock washer M10	
41	12			Hex. nut M10	
42	1m	2m	10m	Seal cord 3 x 1,5 x approx. 1000	
43	1			Diffusor	
44	6			Socket head cap screw M5 x 25	
45	6			Washer M5	
46	6			Strain washer M5	
47	6			Circlip ∅ 10 x 1	
48	1			Blade-ring (Ring Pos. 49 as alternative)	
49	1			Ring (Blade-ring Pos. 48 as alternative)	
			3	PTFE compound ring for mechanical seal	

Rev:	Date:
0	2.10.2000

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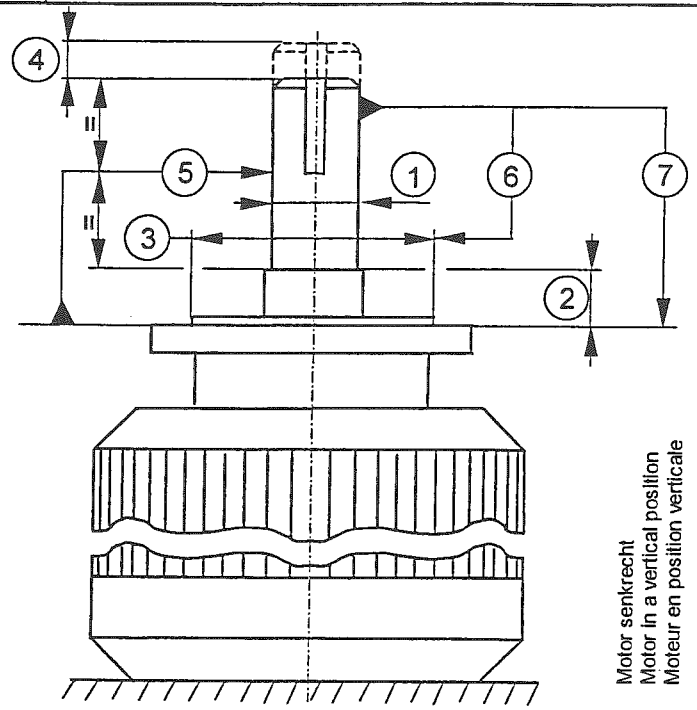
Checkliste / Checklist / Liste de Contrôle
Pumpe / Pump / Pompe C-19

4 12817

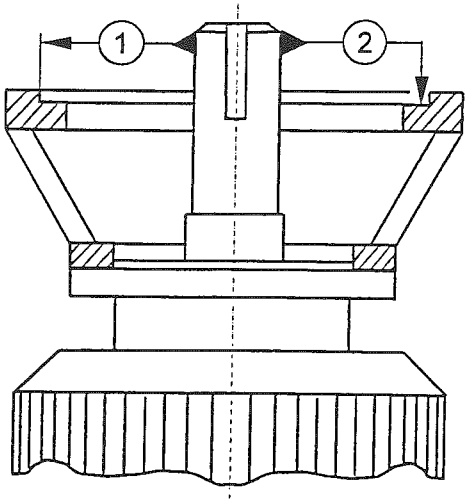
Motor Nr. / Moteur no.	Pumpe Nr. / Pump no. / Pompe no.	Ref. / Réf.

A Motor / Moteur



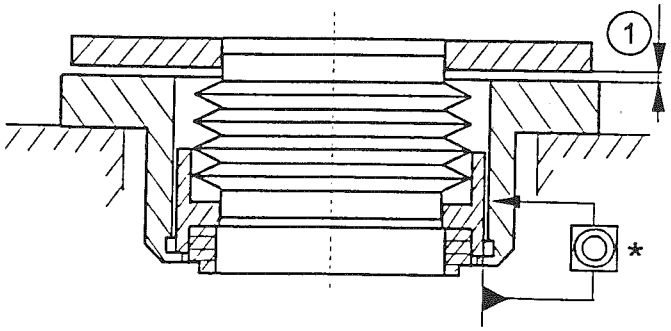
	min.	max.	gemessen measured mesuré
1	23,993	24,007	
2	68,9	69	
3	129,989	130,014	
4	-	-	
5	-	0,04	
6	-	0,05	
7	-	0,05	

B Support - Welle / Support - Shaft / Support - Arbre



	min.	max.	gemessen measured mesuré
1	-	0,07	
2	-	0,07	

C Gleitringdichtung - Führungsbüchse / Mechanical seal - Lead bushing / Joint mécanique - Manchon de guidage

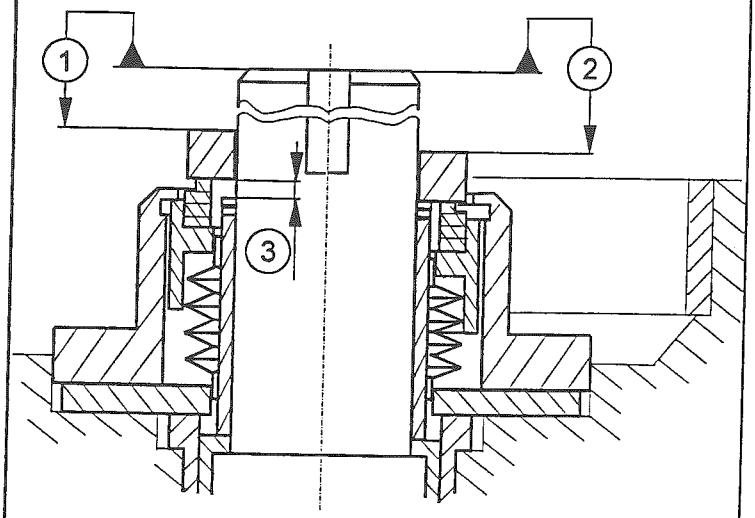


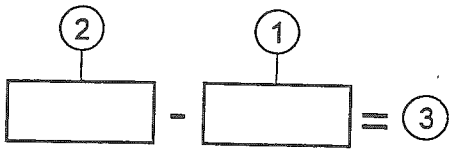
	min.	max.	gemessen measured mesuré
1	0,8	1,5	

Bestmögliche Konzentrizität einhalten
* Observe best possible concentricity
Respecter la meilleure concentricité possible

REV	Date	Drawn	Checked	
0	13.02.02	MR		

D Gleitringdichtung - Gleitring / Mechanical seal - Rotating ring / Joint mécanique - Bague tournante





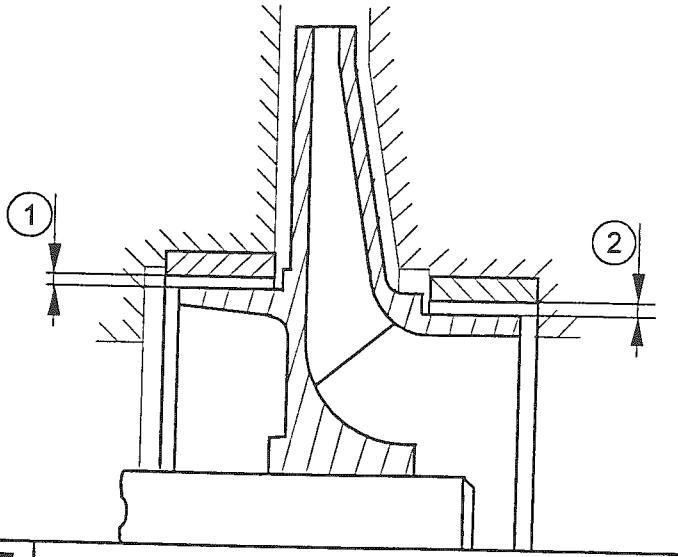
	min.	max.	gemessen measured mesuré
3	2,3	2,6	

Um Maß 3 einstellen zu können, siehe in Kapitel 13 der Betriebsanleitung den Abschnitt "Messvorgang".

To adjust measure 3 see the "Measuring procedure" in chapter 13 of the Instruction manual.

Pour ajuster la cote 3, voir le paragraphe " Procédure de mesure" du chapitre 13 du Manuel d'instruction.

E Laufrad - Spaltringe / Impeller - wear rings / Roue - bagues contre labyrinthes



	min.	max.	gemessen measured mesuré
1	0,17	0,25	
2	0,17	0,25	

F Endkontrolle / Final control / Contrôle final

Dreht die Pumpenwelle frei?
Is the pump shaft rotating free?
Est ce que l'arbre de la pompe tourne librement?

Ja
Yes
Oui ☐

G Dichtheitsprüfung GRD / Tightness test mechanical seal / Contrôle de l'étanchéité du joint mécanique

Prüfdruck / Test pressure / Pression d'épreuve: 7 bar

nach 15 Minuten / after 15 minutes / après 15 minutes:

min.	gemessen measured mesuré
4 bar	bar

Datum / Date	Monteur / Fitter	Kontrolliert / Checked / Contrôlé	