Instruction Manual
for
Liquid Gas Centrifugal Pump

LAR Reflux Pump P40100

Pump - Type	:	CL-19/EM-11
Sefco Ref. No.	:	05.040
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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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:** CL-19/EM-11
- **Ref. No.:** 05.040
- **Tag No.:** P40100
- **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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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, contactless labyrinth seal-gas system, safety-,rotating-and performance components.
- Purge-gas chamber with connections at motor shield.
- 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.
- screwing are stainless-steel

Support : - stainless-steel

Pump shaft : - stainless-steel

4.2 Seal gas control

The supplied seal-/purge gas control box has all components built in. On this box all necessary connections for piping between pump and box as well as necessary electrical connections are provided.

The standard version of SEFCO corresponds to drawing No. 4 10199 and adjusts, after completed setting of the pressure regulator, automatically the required seal gas pressure to the operational conditions. (see schematic No. 4 10205)

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

Seal- and purge gas control-box for automatic control.

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)
- Seal leakage detection :
  Machine shut down in case the temperature at the labyrinth-seal is falling below a set limit.
- Other subsystems on customer request.

6 Machinery and Subsystems data

6.1 Machinery Data

Fluid	:	LOX + LAR		
Specific weight (kg/l)	:	1.151		
Centrifugal pump				
Type	:	CL-19		
Material / Cold end	:	bronze		
Material / Impeller	:	bronze		
Number of stages	:	1		
Impeller diameter / standard (mm)	:	190/6.5		
Impeller diameter / nominal (mm)	:	190		
Nominal speed (min^{-1})	:	3220	3100	2980
Differential head Δ H (m)	:	48.9	47.9	47.1
Differential pressure Δ p (bar)	:	5.52	5.41	5.33
Flowrate (lit/min.)	:	550	486	398
Required NPSH (m)	:	0.6	0.6	0.6

Sealgas-labyrinth-sealsystem

Sealgas :		
Medium	:	Dry nitrogen (< 2ppm)
Temperature (°C)	:	15-20
Required sealgas pressure (bar g)		
- at the seal	:	1.5
- at the control box inlet	:	4
Sealgas capacity (Nm^3/h)		
oil-and dustfree, completely dry (< 2ppm)	:	approx. 5
Purgegas :		
Medium	:	Dry nitrogen
Temperature (°C)	:	15-20
Required purgegas pressure (bar g)		
- at the purge chamber	:	min. 0,2 max. 1
- at the control box inlet	:	approx. 4
Purgegas capacity (Nm^3/h)		
(oil-and dustfree, dew point min. -50°C)	:	approx. 1

Electric motor

Manufacture	:	Theo Halter GmbH
Type	:	DDG 160 MA2
Frame Size	:	160M
Design-Form	:	IMB34
Rated Power (kW)	:	11
Rated current (A)	:	19,9
Rated Frequency (Field weakening point) - (Hz)	:	50
Rated Rotating Speed (min^{-1})	:	2920 / max. admissible: 3400
Protection / Insulation Class	:	IP55 / F used B
Max. ambient temperature / installation altitude (°C /m above sea level)	:	40 / 1000
Y - Voltage / Frequency / Phases (V / Hz)	:	400 / 50 /3
Motor fixing device, drawing No.	:	4 13614

Variable Frequency Drive (VFD)

Manufacture	:	)
Type	:	)
Protection	:	)
Ambient Temperature (°C)	:	) Air Liquide supply
Mains Voltage / Frequency / Phases (V / Hz)	:	)
Rated output Current (A)	:	)
Rated output Frequency (Hz)	:	) / max. admissible:
Max. Cable Length to the Motor (m)	:	)

6.2 Additional Subsystems and Components

- Closure plate
- Suction strainer DN65
- Flexible suction hose DN65 PN6
- Flexible discharge hose DN40 PN40
- Seal leakage detection RTD's
- Control box labyrinth-seal

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“)

The pump unit must be mounted and aligned with joined damping elements

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.

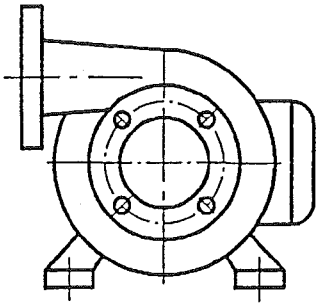
It is recommended to finally fix the holding down bolts of the machine only in cooled down condition.

Minimise flow disturbances at pump-inlet.

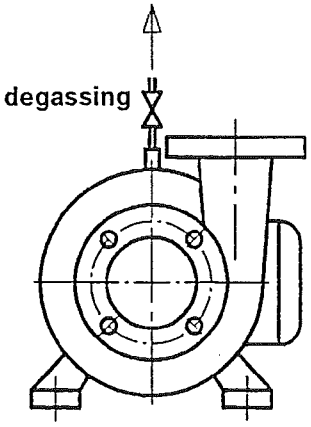
NOTE!

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.

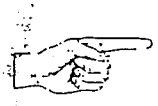
8.4 Electric connections

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!

8.5 Purge-and seal gas control

Drawing 4 10205 shows a typical installation schematic, corresponding to the SEFCO-standard-solution. All versions supplied by SEFCO which may differ depending on the application can be found in the joined schematics in the annex.

RECOMMENDATION!

Minimum equipment should include at least the following components:

- Main valve 1
- Non-return valve 4
- Control valve 3
- Differential pressure regulator (PDC)
- Differential pressure gauge (PDI)

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!

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

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:

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

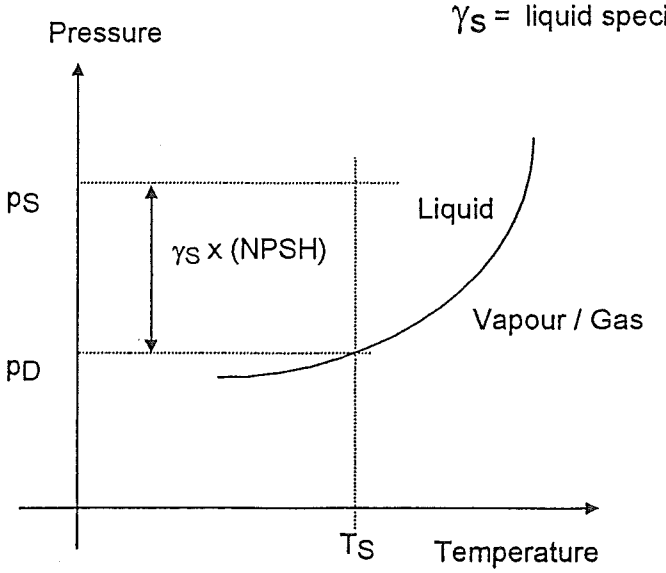
CAUTION!

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
  - hex. cap screw located in the centre of the motorshaft NDE, 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.

10.2 Operation start-up (see schematic No. E10200-1 and 4 10205)

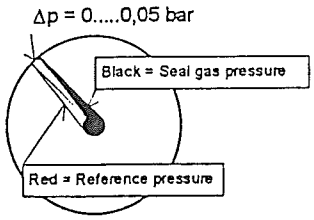
CAUTION!

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

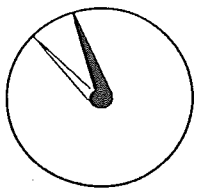
During cool-down or warm up it is possible that the pump is slightly turning.
The rotational speed should not exceed 150 rpm.

10.2.1 Seal-/ purge gas control (Schematic 4 10205)

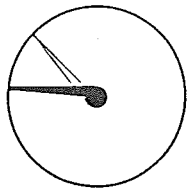
Prior, during and after pump operation, the **seal gas pressure** should be 0..... 0,05 bar above the reference-pressure (PDI) :



Optimum



Seal gas pressure too high
⇒ Pollution of pumped fluid possible



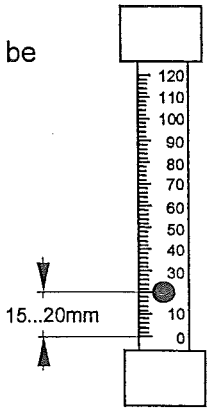
Seal gas pressure too low
⇒ Pump is leaking

Before starting the pump, the sealing-chamber must be under seal gas-pressure for at least 60 minutes, in order to evacuate air and moisture which could condense and freeze.

This will be satisfied by opening the main-valve **1** and by adjusting of the above given pressure-difference on the Differential pressure regulator (PDC).

Prior, during and after pump operation, the **purge gas pressure** should be approx. 0,01 .... 0,05 bar. Pressure adjusted with valve 3; the purge gas flowrate should be approx. 0,5 Nm^3/h.

This adjustment corresponds with approx.15...20mm on the flowmeter (Fl-2) as in the annexed sketch.



10.2.2 Cool-down of the pump (cold-end) Schematic E10200-1

WARNING!

Observe chapter 3 „ Safety " when operating the pump.

- Start purge-and seal gas system. (see § 10.2.1)
- 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.

10.2.3 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 labyrinth- and driving parts.

10.2.4 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**.
- Close valve **7**.
- Close main valve **1** of purge-/seal gas control once the pump has come **completely** to ambient temperature. **(avoid condensation)**.

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 bearing damage Bad bearing lubrication Unbalance External tubing forces too high for the pump casing	Replace bearings Regrease or replace life greased bearing Replace impeller or inducer or possibly re-balance (SEFCO) Check fix points Exactly align pump and tubing (see § 8.2)

Operation disturbances (continuing)

Disturbance	Possible reason	Correction pump *not operating*
Unusual bearing temperature	Motor bearings damage	Replace bearings
	Bad motor bearings lubrication	Regrease or replace life greased bearings
Pump leaks	Seal gas supply insufficient Seal gas pressure too low	Check seal gas supply. Adjust with differential pressure regulator: (Seal gas pressure between 0.....0,05 bar > Reference pressure)
	Purge gas pressure too high	Throttle valve 3 (15...20mm)
	Ice formation or dirt in the labyrinth seal	Check seal gas if it is dry (< 2ppm) and clean
	Seal worn out	Replace labyrinth seal
	Leak in the seal gas supply	Leak detection, tighten fittings
	Seal-/purge gas connections incorrect	Check connections (see schematic 4 10205)

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
Unusual noises	Flowrate too high or low	Adjust flowrate
Pump leacks	Seal gas supply insufficient Seal gas pressure too low	Check seal gas supply. Adjust with differential pressure regulator: (Seal gas pressure between 0.....0,05 bar > Reference pressure)
	Purge gas pressure too high	Throttle valve 3 (15...20mm)
	Ice formation or dirt in the labyrinth seal	Check seal gas if it is dry (< 2ppm) and clean
Pressure and Flowrate too low	Low rotation speed	Check rotation speed

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 electric motor overhaul 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
- Replace damping elements (Motor fixing devices)

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 regrease during standstill or at rotating speeds above 3500 rpm.
- Electric motor bearing grease: Klüber Isoflex Alltime SL 2

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 12015)

WARNING!

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.
- Disconnect seal and purge gas connections.
- 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 **46**, washers **45** and pull off pump casing **41**.
- Remove screws **43** and wear ring **42** from pump casing only if necessary to change. **(using take-off device)**
- Remove flattened seal-cord **47**.(Casing seal)
- Remove circlips **52**, screws **49**, washers **50** and **51** only if diffusor **48** has to be changed.
- Remove circlip **40**, safety screw **39**, screw **38** and strain washers **37** and draw-off impeller cap **34** or inducer **35**.
- Draw-off impeller **32** with keys **33** from shaft.
- Remove swirl wheel **31** and shims **30**.
- Remove screws **21**, washers **20** and rear-casing **16** from support **4** as a unit. (observe position)
- Dismount labyrinth-holder **27,** not to be further dismantled. Part should be sent to manufacturer for maintenance.
- Remove screws **18** and wear-ring **17** from rear-casing only if necessary to change. **(using take-off device)**
- If replacement is required, remove screws **24**, strain washers **23** and dismount cover bushing **22** carefully.
- Remove insulation-ring **19**, labyrinth-bushing **15** and labyrinth wheel **14**.
- Remove screws **3** and dismount front slinger disc **2**.
- Remove screws **12**, strain washers **11** and dismount purge-chamber **8**. Remove distance-ring **13** and rear slinger-disc **2**.

  If support 4 should be dismounted, mark its position to motor-shield before removal; same condition applies for motor-shield as to motor.
- Remove screws **7**, strain washers **6** and dismount support **4**.

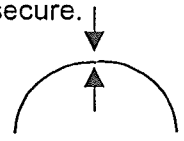
13 Pump Assembling (Drawing No. 2 12015 and Checklist No. 4 12819)

WARNING!

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.**
- Position tolerance for electric motor:
  - Running tolerance of shaft (at $^{L}/_{2}$) : 0,015 mm
  - Co-axial motorflange-concentricity : 0,030 mm
  - Motorflange plane-run : 0,030 mm

  Measurement according to DIN 42955
- Mount rear slinger-disc **2** on motor shaft with screws **3**. (align screws to flattened areas)
- Mount support **4** on motor-flange. (observe position)
- Mount purge-chamber **8**, distance-ring **13** and second slinger-disc **2**. (align screws **3** to flattened areas)
- Place labyrinth-wheel **14** and labyrinth-bushing **15** on shaft.
- Mount wear-ring **17** in rear-casing **16** and **42** in pump casing **41** and secure with screws **18 / 43**. Slightly hammer screw-thread to secure.
- Mount diffusor **48:**
  Observe position according to sketch, secure screws **49** with circlips **52**.



- Heat cover-bushing **22** to 50-60°C, slip on rear-casing **16** and secure with screws **24**.
- Place softened seal-washer **25** in rear-casing **16**. (observe position)
- Place O-ring **26** on labyrinth-holder **27,** mount the unit carefully in rear-casing **16** and tighten **uniformly** with screws **29 considering the positioning-pin!** It is most important that these screws are uniformly tensioned.
- Place insulation-ring **19** and rear-casing **16** in support **4** and fasten with screws **21**. (observe position)

- Measure running-tolerance at inner diameter of labyrinth holder **27**. The deviation must not exceed 0,05 mm.
- check that shaft rotates freely.
- Adjust measure **A = 1,4 ± 0,1 mm** by peeling shim **30**. This shim consists of sheet-metal layers (0,05 mm thickness) which can be peeled off separately.
- Place swirl-wheel **31** and impeller **32**.
- Place both keys **33**. Mount impeller-cap **34** or inducer **35** and tighten screw **38** at approx. 38 Nm. Secure with screw **39** and circlip **40**.
- Put self adhesive seal-cord **47** on seal-face of pump casing **41, ends overlapped**.
- Mount pump casing **41** and tighten uniformly.

CAUTION!

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

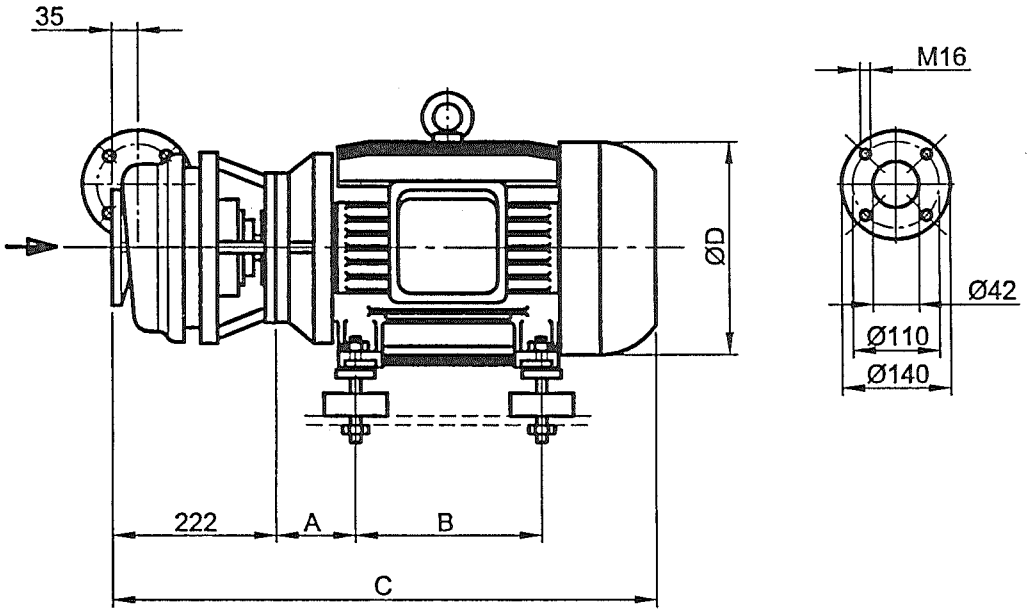
Same control of free-rotating after pump installation and before motor-start

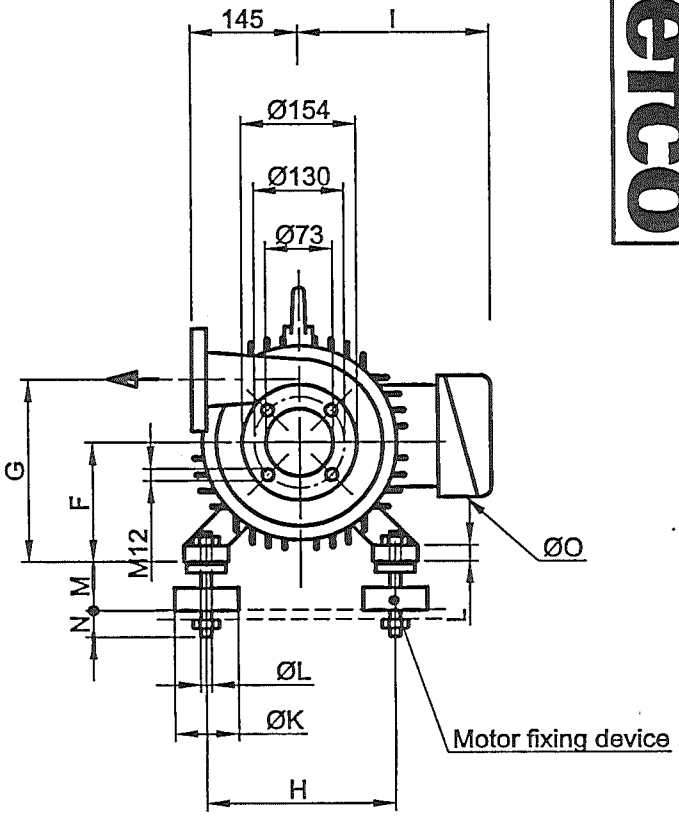
Gezeichnet / Dessiné	Geprüft / Controlé
22.08.2000	NS.

Gezeichnet / Dessiné	Geprüft / Controlé

LIQUID GAS CENTRIFUGAL PUMP
Type : CL- 19

sefco





" External forces according to drawing 4 13576 "

Subject to change

Dimensions in mm

Motor type	kW	A	B	C	D	E	F	G	H	I	K	L	M	N	O	P	Q
225M		149	311	925	431		225	309	356	365	75	M12	75-85	37	2 x Pg36		
200L		133	305	880	392		200	284	318	329	75	M12	75-85	37	2 x Pg36		
180M		121	241	929	341		180	264	279	280	75	M12	75-85	37	2 x Pg29		
160M		108	210	740	310		160	244	254	245	50	M10	36-42	28	2 x Pg29		
132S		89	140	600	260		132	216	216	213	50	M10	36-42	28	2 x Pg21		
112M		70	140	551	220		112	196	190	191	50	M10	36-42	28	2 x Pg16		

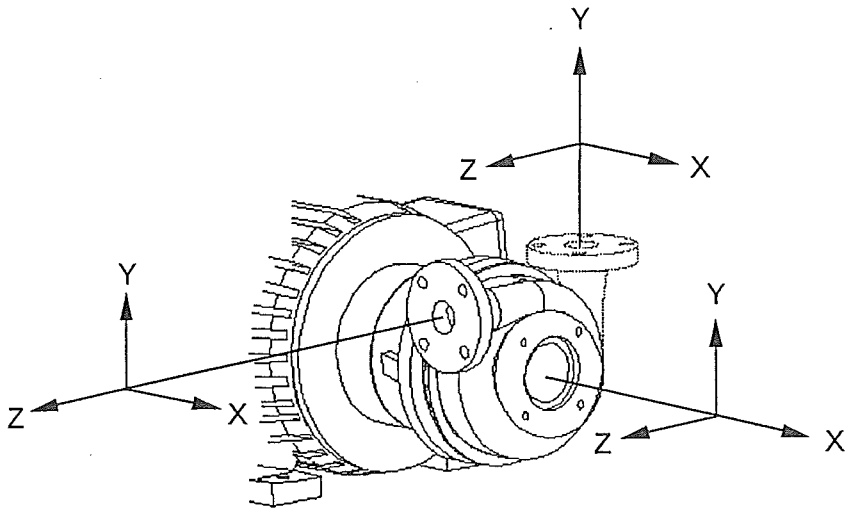
4 12190

Maximale Flanschbelastungen / Kräfte- Momente

Max. Nozzle Loadings / Forces- Moments

Efforts max. aux brides / Forces- Moments

Pumpen-Typ :
Pump- Type : **C-19, C-19/G2, C-19/PA, CL-19**
Pompe- Type :



		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

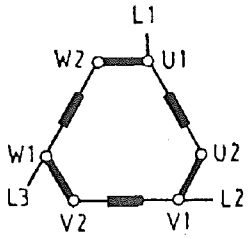
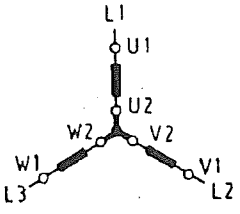
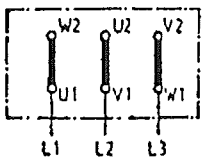
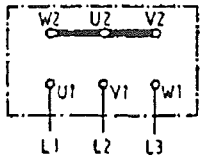
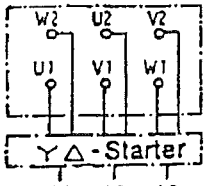
Connection for squirrel cage induction motors

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

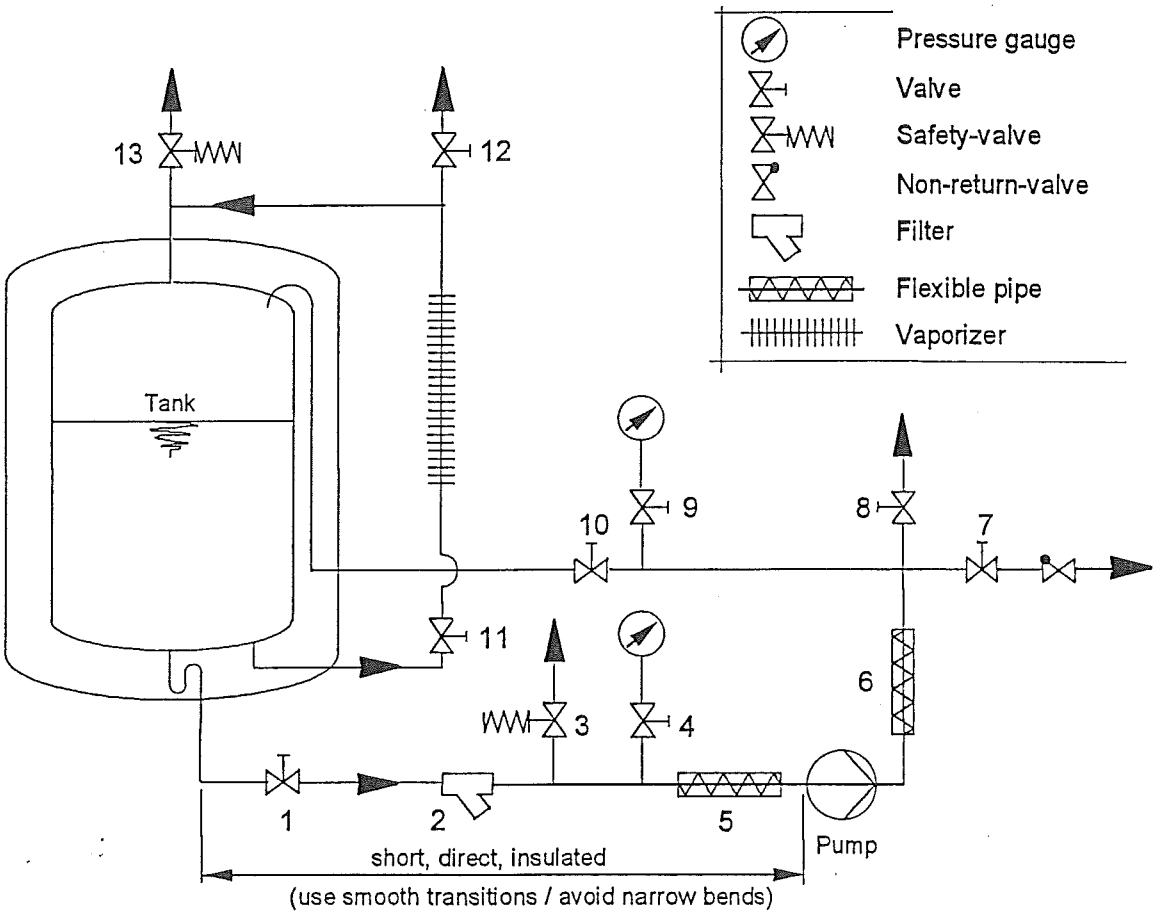
The connection of links and lines on the terminal board are dependant of the rated voltage and winding phase; e.g. for a squirrel cage induction motor with winding phase for 230 V Δ / 400 V Y with one speed the following connections must be done:

	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.

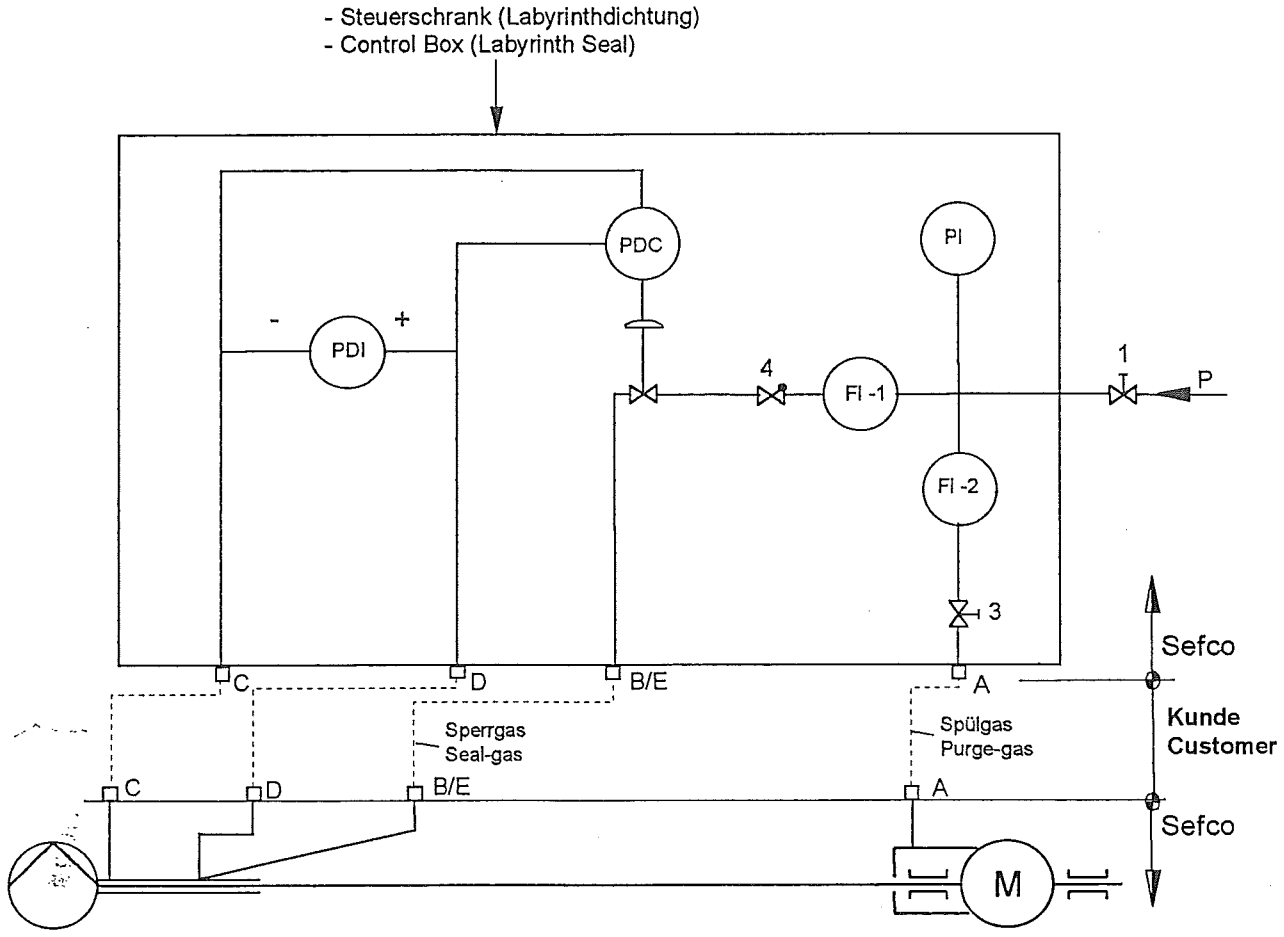
Installation schematic for centrifugal pump

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	

Schema Sperr- Spülgasregulierung / Scheme seal- purge gas Regulation



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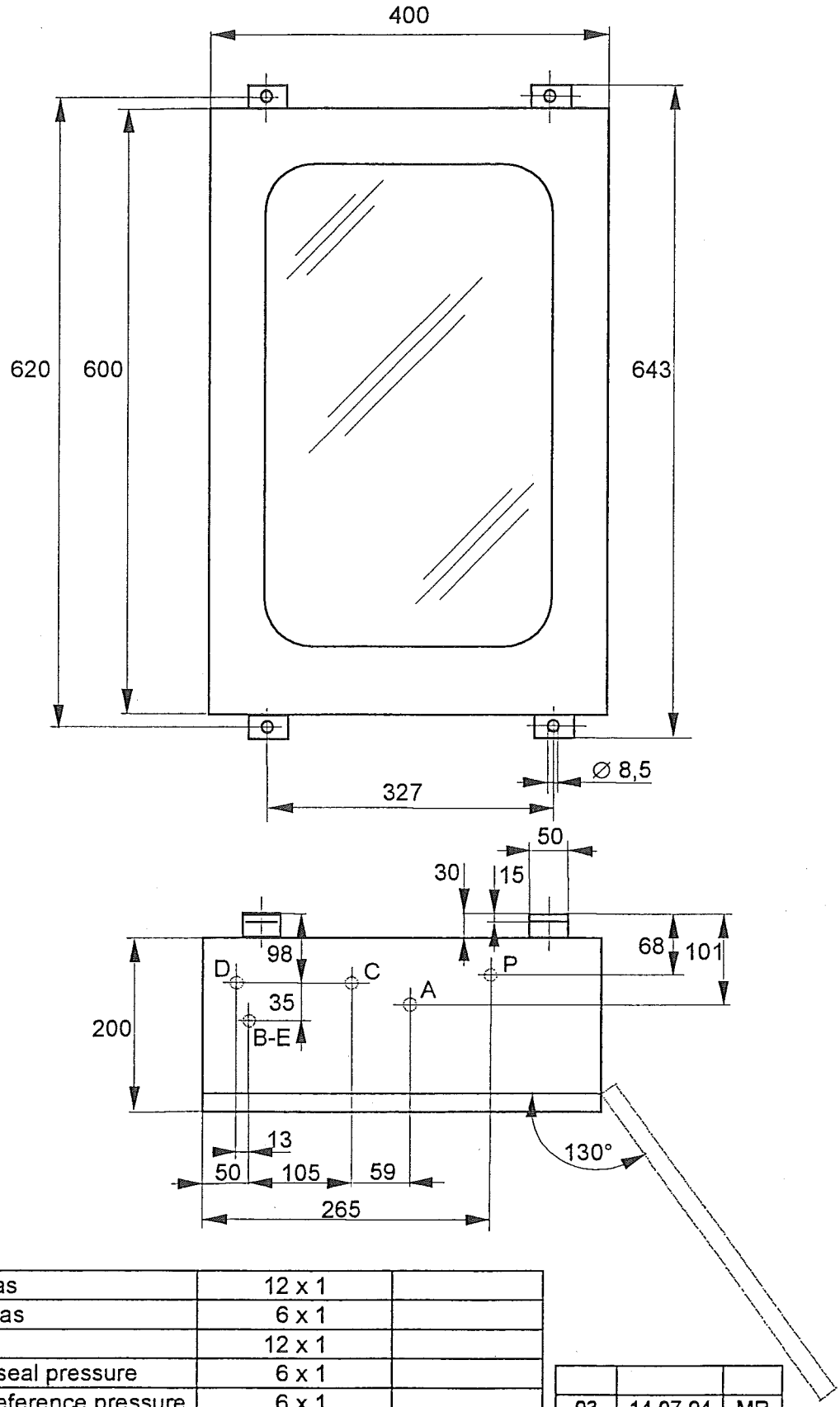
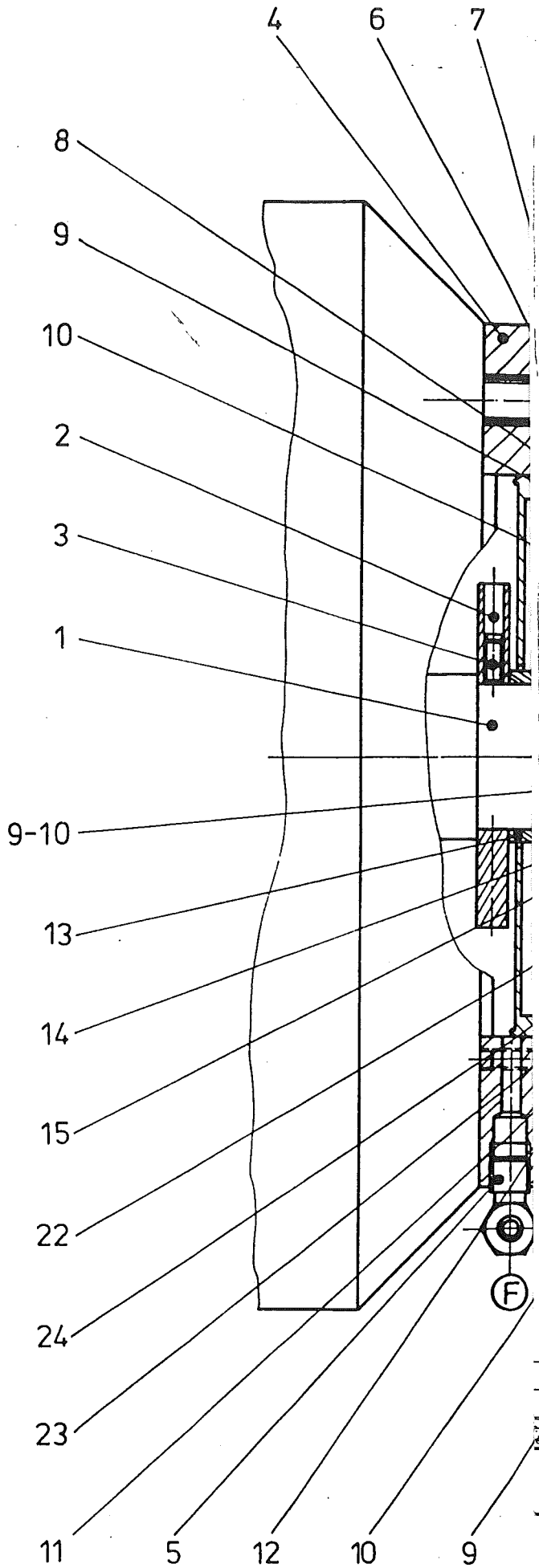
STEUERSCHRANK LABYRINTHDICHTUNG
CONTROLBOX LABYRINTH- SEAL

4 10199



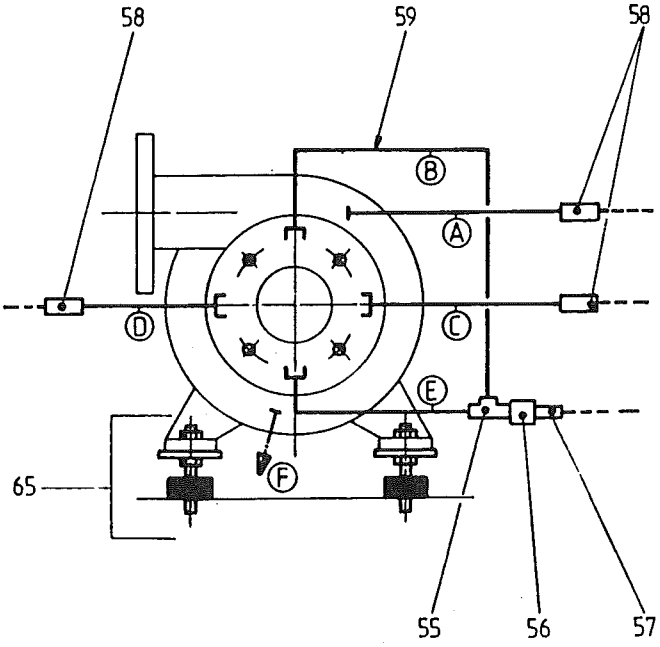
B-E	Sperrgas / seal gas	12 x 1	
A	Spülgas / purge gas	6 x 1	
P	Speisung / feed	12 x 1	
C	Dichtungsdruck / seal pressure	6 x 1	
D	Referenzdruck / reference pressure	6 x 1	
		Rohr Ø / Tube Ø	

03	14.07.94	MR
Rev.	Date	dwg



Anschlüsse / Connections

Pos.	Anschlussart (Funktion) / Connexion Type (Function)	Rohr-ø / Tube-ø (mm)
A	Spülgas Eingang / Purge-gas inlet	6/4
B·E	Sperrgas Eingang / Seal-gas inlet	6/4, 6/4 > 12/10
C	Dichtdruck (Sperrgas) / Seal-gas pressure	6/4
D	Referenzdruck (Prozessgas / Reference-pressure (process	6/4
F	Spülgas-Auslass / Purge-gas outlet	6/4



Gegenstand / Spécification	Pos. / Rep.	Werkstoff / Matière		Modell / Modèle	Bemerkungen / Observations

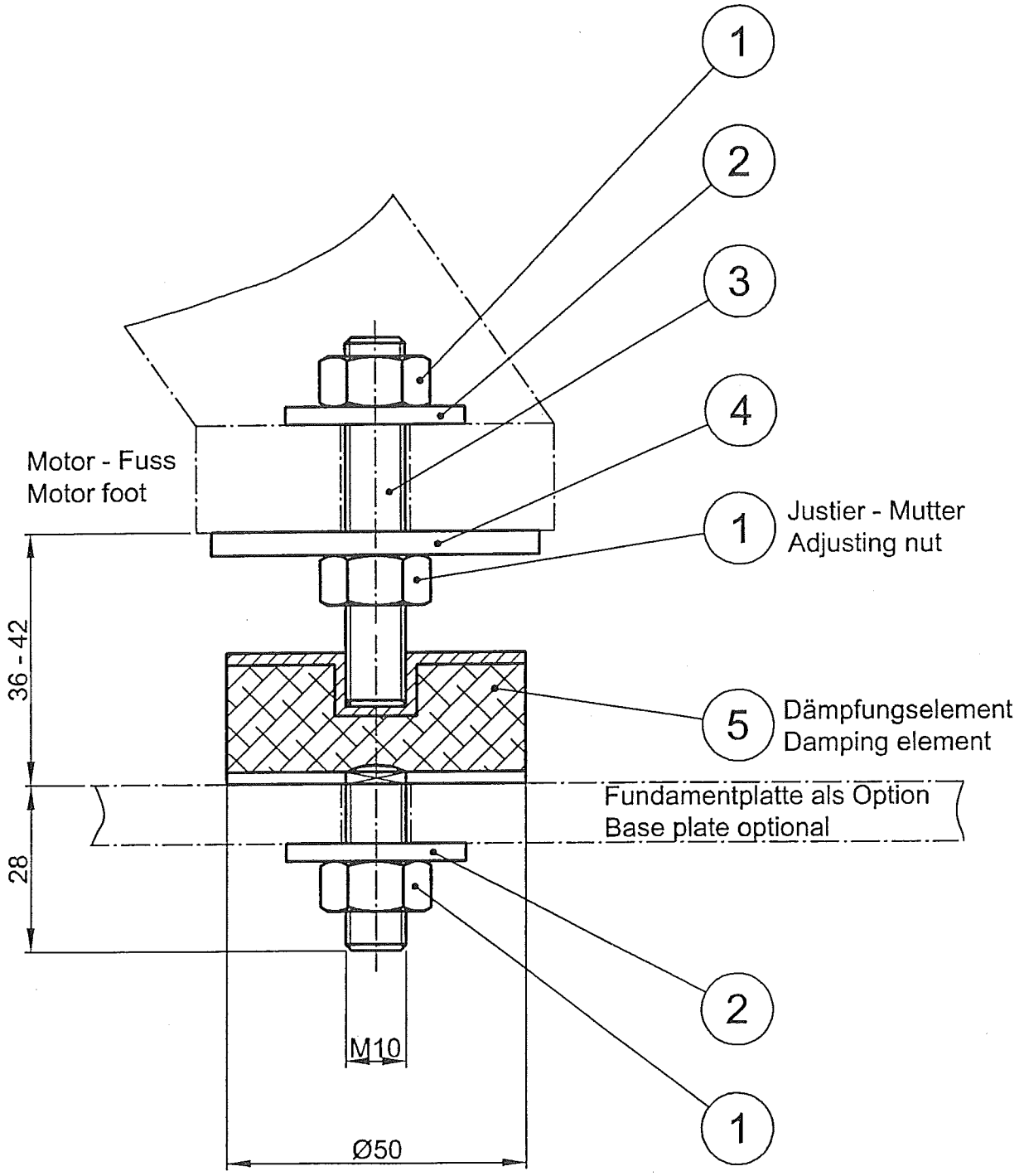
Ersetzt durch: / Remplacé par:
Ersatz für: / Remplace:

tes Ende (Cold End)

Maßstab / Echelle	Gezeichnet / Dessiné	08-10-91	
1/1	Geprüft / Contrôlé		
	Genehm. / Vu		

2 12015

sefco	Motor Befestigung Motor fixing device	4 13614



Gezeichnet Dessiné	Geprüft Controlé
NS	
29.08.2000	

CL-19, Drawing: 2 12015 **Cold End**

Item-No.	Parts per Unit	Required Spare Parts	Recommended Spare Parts	Nomenclature	Material
1	-			Motorshaft end	
2	2			Slinger disc	
3	4			Socket set screw M5 x 10	
4	1			Support	
5	1			Fitting	
6	4			Strain-washer M10	
7	4			Socket head cap screw M10 x 30	
8	1			Purge chamber	
9A to 9E	5			Fitting	
10	10			Seal washer ∅ 13,5 x 10 x 1	
11	4			Strain-washer M5	
12	4			Socket head cap screw M5 x 20	
13	1			Distance-ring	
14	1		1	Labyrinth-wheel	
15	1		1	Labyrinth-bushing	
16	1			Rear casing	
17	1	1	1	Wear-ring	
18	2			Socket set screw M5 x 10	
19	1			Insulation-ring	
20	4			Washer M5	
21	4			Socket head cap screw M5 x 30	
22	1			Cover-bushing	
23	4			Strain-washer M5	
24	4			Socket head cap screw M5 x 12	
25	1	1	2	Seal-washer ∅ 65 x 45 x 0,2	
26	1	1	2	O-Ring ∅ 38 x 3	
27	1		1	Labyrinth-holder complete	
28	8			Strain-washer M5	
29	8			Socket head cap screw M5 x 16	
30	2	1	2	Shim ∅ 30 x 24 x 1	

Rev:	Date:
0	07.12.99

CL-19, Drawing: 2 12015 **Cold End**

Item-No.	Parts per Unit	Required Spare Parts	Recommended Spare Parts	Nomenclature
31	1		1	Swirl-wheel
32	1			Impeller
33	2			Key C8 x 6 x 30
34	1			Impeller cap (Inducer Pos.35 as alternative)
35	1			Inducer (Impeller cap Pos.34 as alternative)
36	2			Spring tension pin ∅ 3 x 8
37	2			Strain-washer M10
38	1			Socket head cap screw M10 x 35
39	1			Safety screw M20 x 1
40	1			Circlip ∅ 20 x 1
41	1			Pump casing
42	1	1	1	Wear-ring
43	2			Socket set screw M5 x 10
44	12			Stud M10 x 60
45	12			Strain-washer M10
46	12			Hexagon nut M10
47	1m	2m	10m	Seal-cord 3 x 1,5 x approx. 1000
48	1			Diffusor
49	6			Socket head cap screw M5 x 25
50	6			Washer M5
51	6			Strain-washer M5
52	6			Circlip ∅ 10 x 1
53	1			Blade-Ring (Ring Pos. 54 as alternative)
54	1			Ring (Blade-Ring Pos. 53 as alternative)
55	1			Fitting
56	1			Tube adapter
57	1			Fitting
58	3			Fitting
59	-			
60	1			Hex cap screw M10 x 20 (on motorshaft-fanside)
61	-			
62	-			

Material	Rev:	Date:
	0	07.12.99

CL19, Drawing: 2 12015 **Cold End** **Motor-Fixing-Device Drawing: 4 13614**

Item-No.	Parts Per Unit	Required Spare Parts	Recommended Spare Parts	Nomenclature
				„ According to Machinery and Subsystems Data § 6 „
65	4			Motor fixing device complete, for E-Motor frame size up to 160, without base plate
1	12			Hexagon nut M10
2	8			Washer M10
3	4			Set screw M10 x 60 (M10 x 80)
4	4			Washer ∅ 60 x 4
5	4			Damping element ∅ 50 x 20

Material	
Rev:	Date:
0	10.05.2005

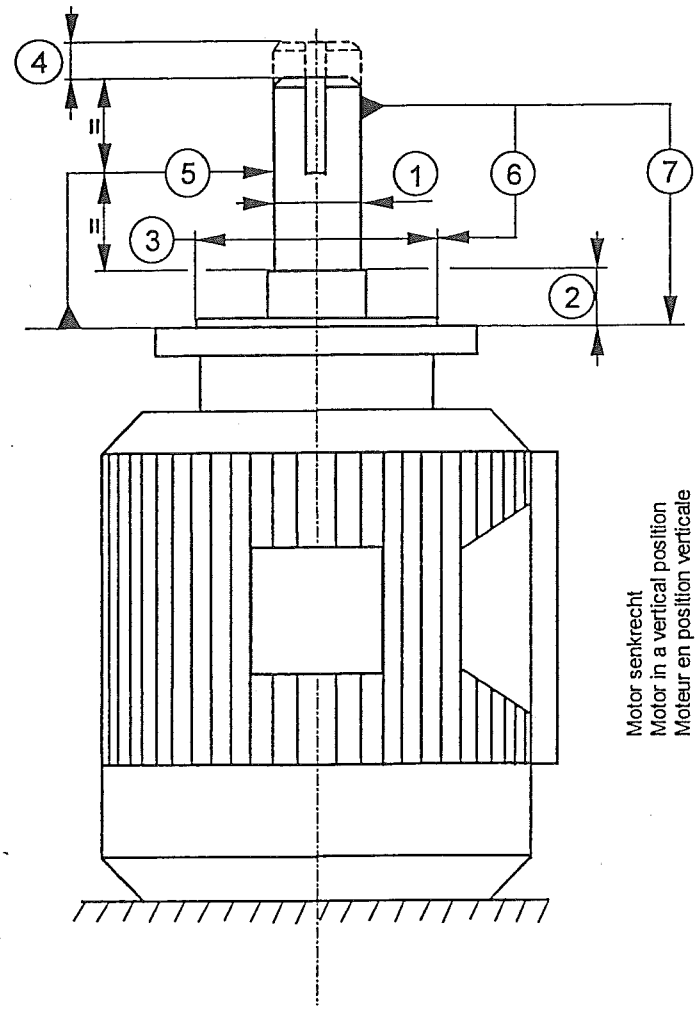
sefco

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

4 12819

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

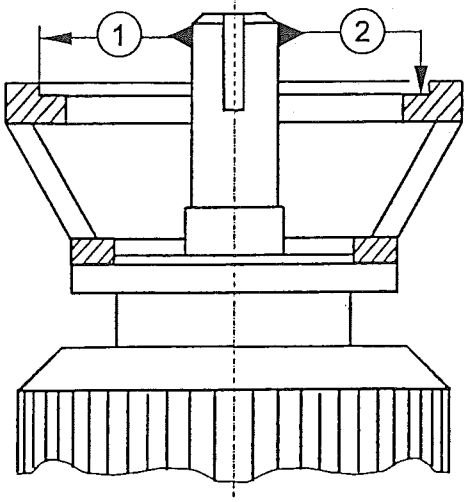
A Motor / Moteur



Motor senkrecht
Motor in a vertical position
Moteur en position verticale

	min.	max.	gemessen measured mesuré
1	23,993	24,007	
2	26	26,1	
3	129,989	130,014	
4	-	-	
5	-	0,015	
6	-	0,030	
7	-	0,030	

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



	min.	max.	gemessen measured mesuré
1	-	0,040	
2	-	0,040	

REV	Date	Drawn	Checked	
0	11.02.02	MR	GL	

ANNEX

		Gezeichnet Dessiné	Geprüft Controlé
0	28.01.2005	C.M.	

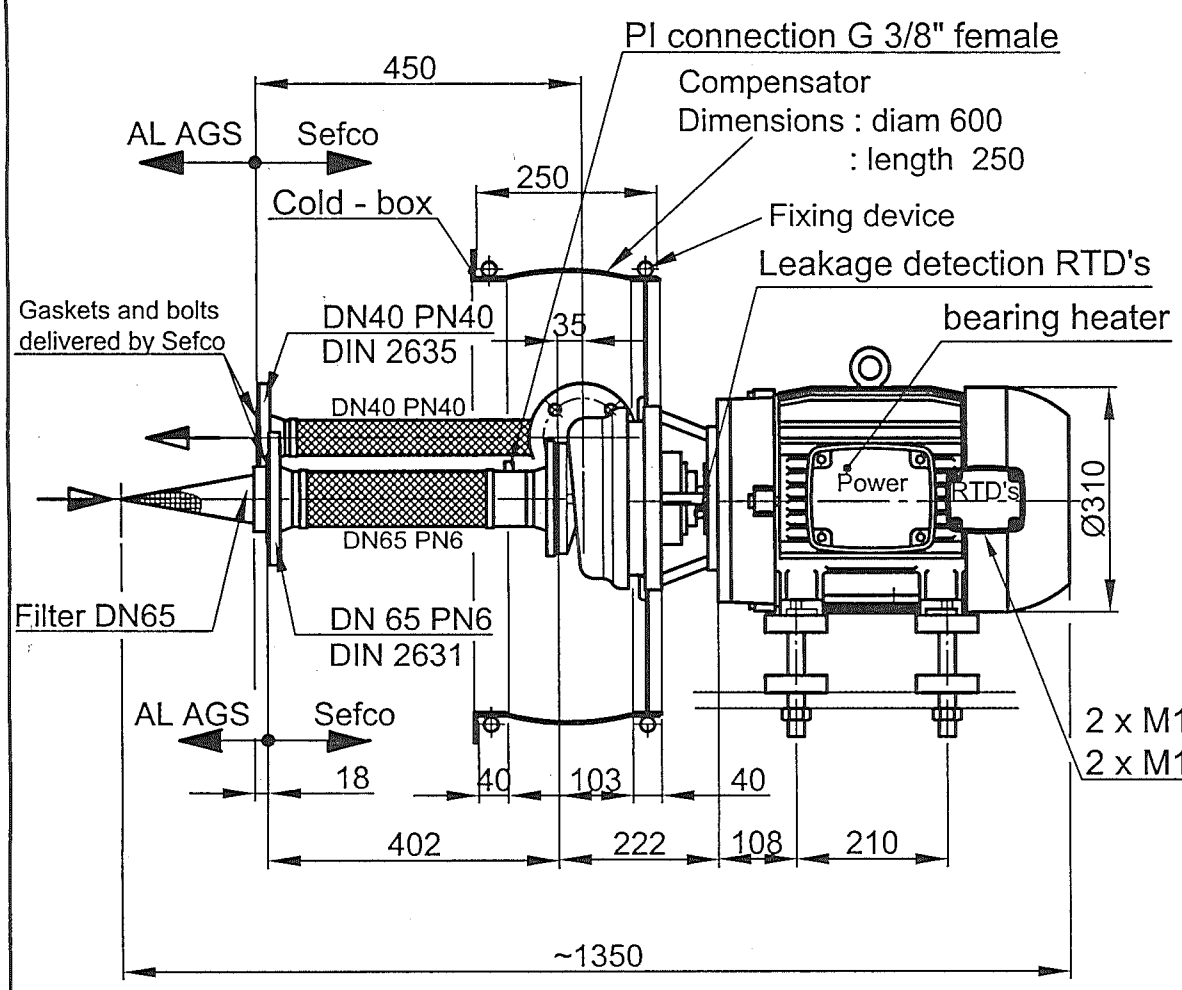
Arrangement drawing : LAR - Reflux Pump P40100

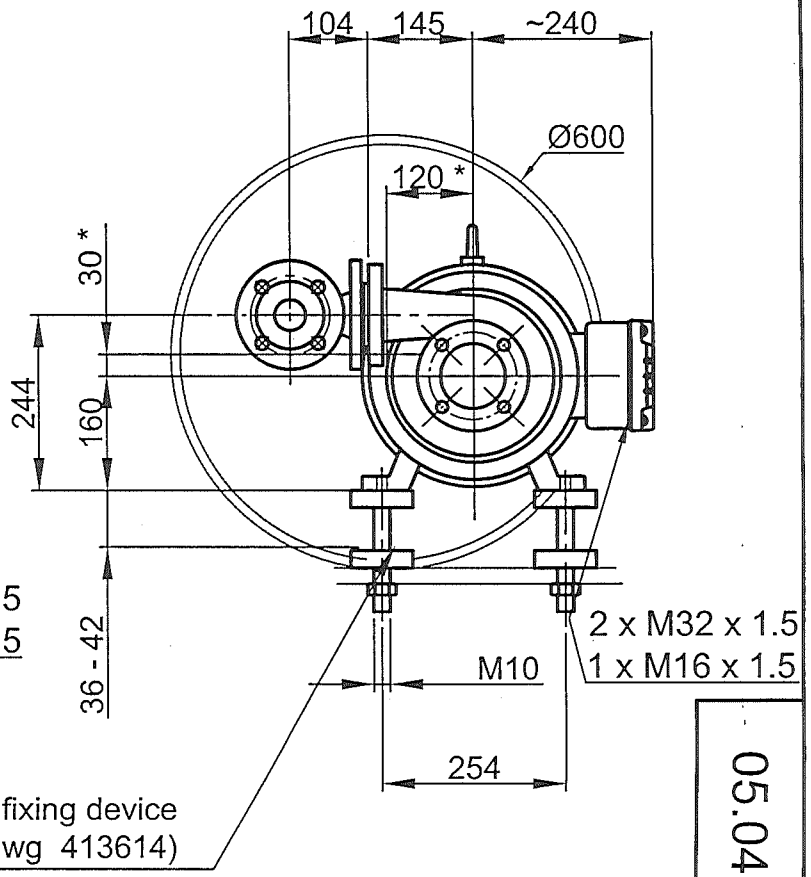
Air Liquide AGS GmbH

4500023387 - "Kosice"

Pump type : CL - 19 / EM - 11
Motor type : 160M - 11 kW
Weight : approx. 175 Kg

sefco





Max nozzle loadings according to drawing 4 13576

* eccentricity (insulation shield)

05.040

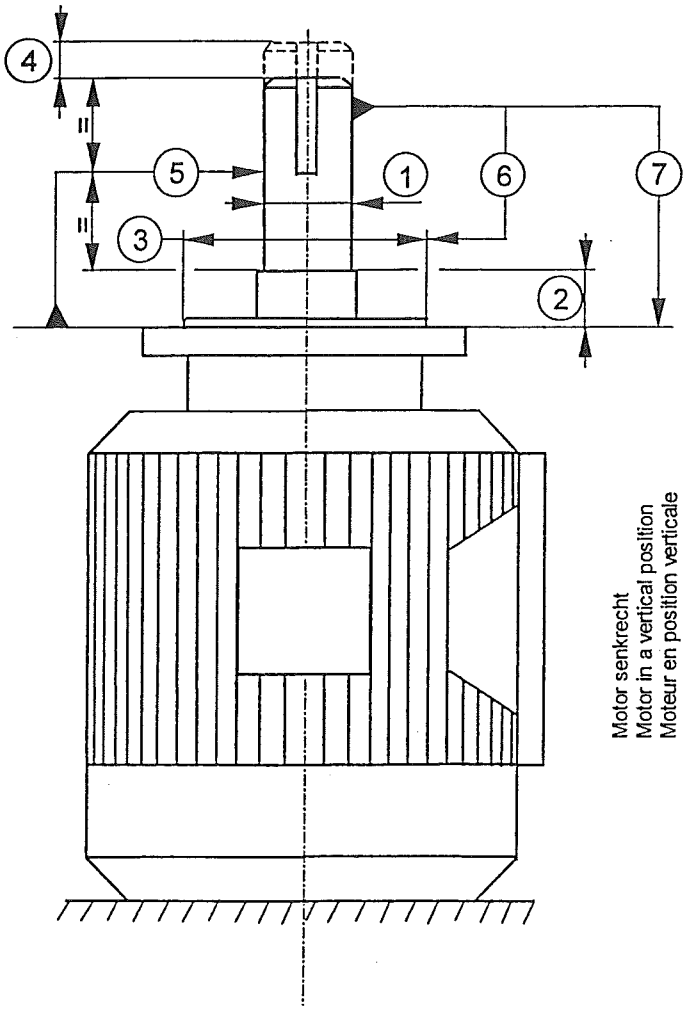
sefco

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

4 12819

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

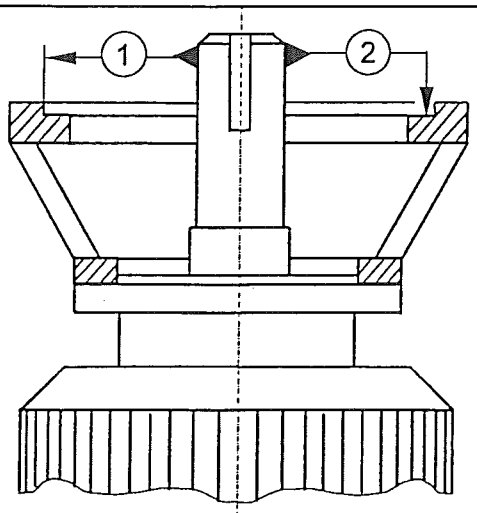
A Motor / Moteur



Motor senkrecht
Motor in a vertical position
Moteur en position verticale

	min.	max.	gemessen measured mesuré
1	23,993	24,007	
2	26	26,1	
3	129,989	130,014	
4	-	-	
5	-	0,015	
6	-	0,030	
7	-	0,030	

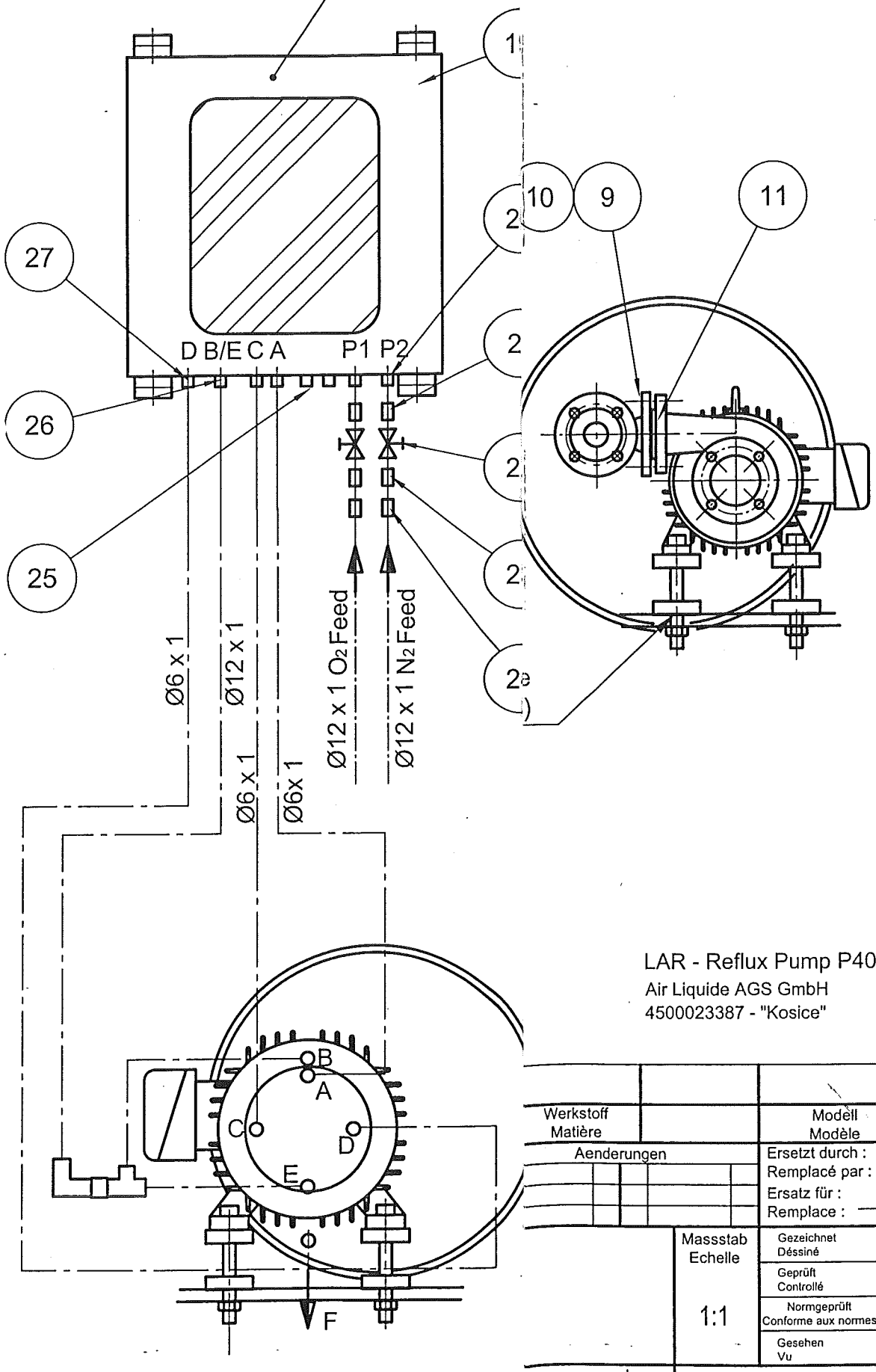
B Support - Welle / Support - Shaft / Support - Arbre



	min.	max.	gemessen measured mesuré
1	-	0,040	
2	-	0,040	

REV	Date	Drawn	Checked	
0	11.02.02	MR	G	

Drawing 4 10



LAR - Reflux Pump P40100
Air Liquide AGS GmbH
4500023387 - "Kosice"

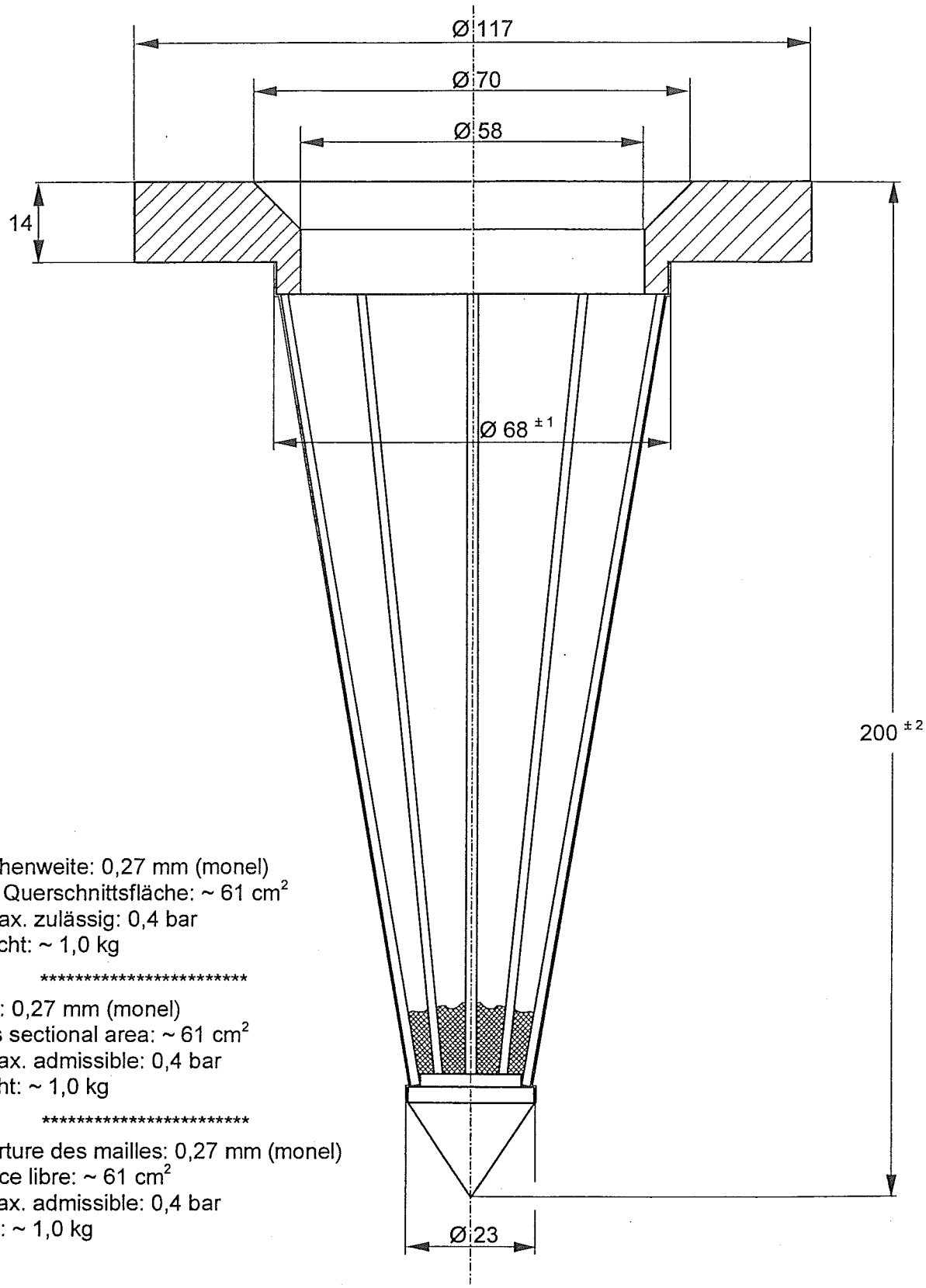
Werkstoff Matière		Modell Modèle	Bemerkungen Observations
Aenderungen		Ersetzt durch : Remplacé par : Ersatz für : Remplace :	
Massstab Echelle 1:1	Gezeichnet Déssiné	N.S.	21.04.2005
	Geprüft Controllé		
	Normgeprüft Conforme aux normes		
	Gesehen Vu		

05.040/14

Drawing: 05.040/14 **Accessories P40100**

Item-No.	Parts per Unit	Nomenclature	Material
1	1	Suction strainer DN 65	
2	2	Gasket Ø 115 x 77 x 2	
3	1	Flexible suction hose DN65 PN6	
4	4	Washer M12	
5	4	Hexagon cap screw M12 x 40	
6	1	Gasket Ø 115 x 77 x 2	
7	1	Gasket Ø 92 x 49 x 2	
8	1	Flexible discharge hose DN40 PN40	
9	4	Hexagon cap screw M16 x 45	
10	4	Washer M16	
11	1	Gasket Ø 92 x 49 x 2	
12	6	Strain washer M6	
13	6	Hexagon cap screw M6 x 20	
14	1	Gasket Ø 255 x 215 x 2	
15	1	RTD's for seal leakage detection	
16	1	Compensator Ø 600 x 250	
17	1	Set of fixing devices for compensator	
18	1	Closure plate Ø 600	
19	1	Control box seal-/purge gas regulation	
20	2	Panel mount union Ø 12	
21	2	Tube stub Ø 12	
22	2	Ball valve Ø 12	
23	2	Female adaptor Ø 12 - 3/8"	
24	2	Male adaptor union Ø 12 - 3/8"	
25	2	Cable gland M12 x 1,5	
26	1	Panel mount union Ø 12	
27	3	Panel mount union Ø 6	
28	1	Male adaptor union Ø 12 - 3/8"	
29	1	Plug Ø 12	
30			
31			
32			
33			

Rev:	Date
0	11.05.2005



Maschenweite: 0,27 mm (monel)
Freie Querschnittsfläche: ~ 61 cm^2
Δp max. zulässig: 0,4 bar
Gewicht: ~ 1,0 kg

****

Mesh: 0,27 mm (monel)
Cross sectional area: ~ 61 cm^2
Δp max. admissible: 0,4 bar
Weight: ~ 1,0 kg

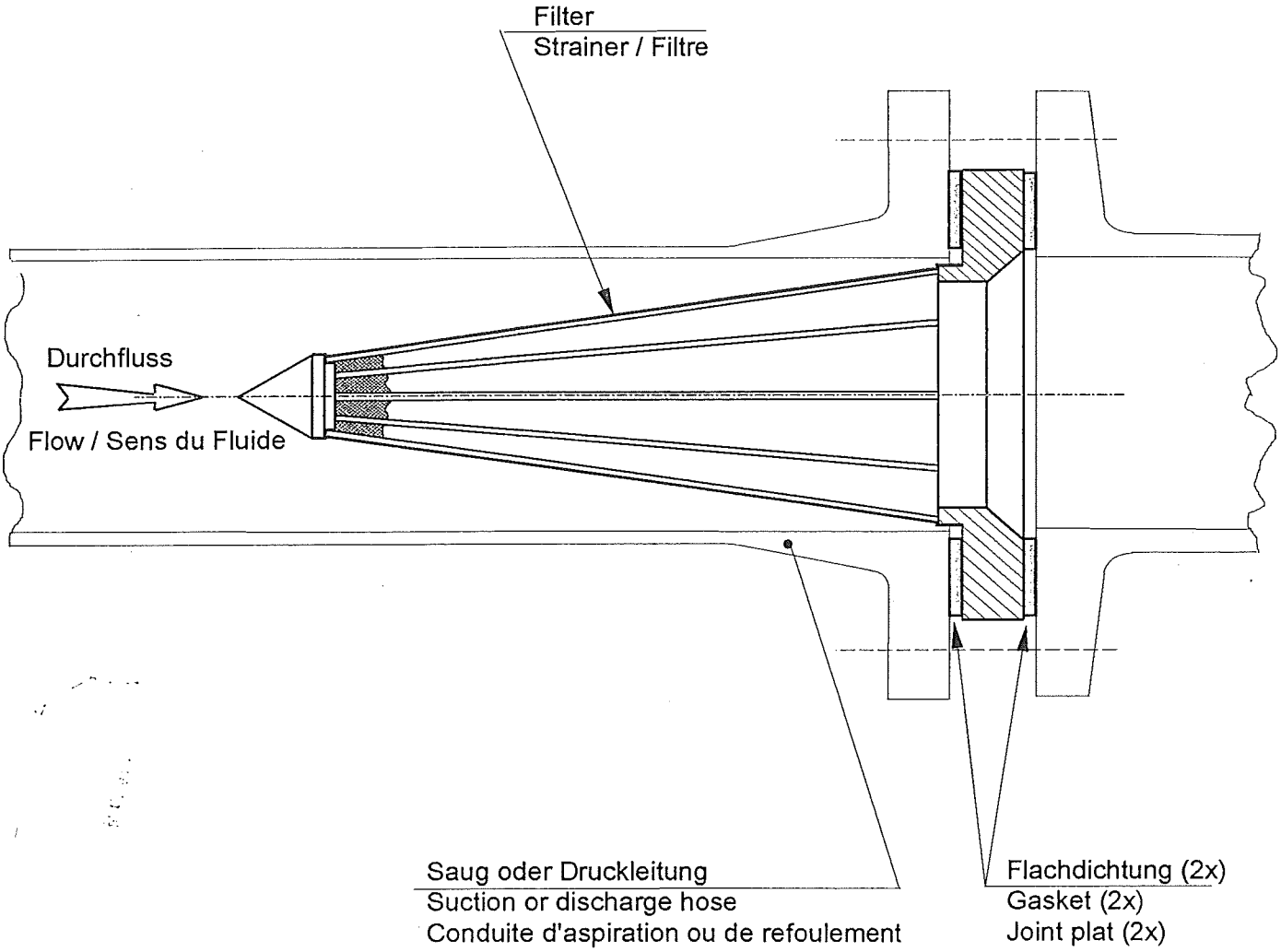
****

Ouverture des mailles: 0,27 mm (monel)
Surface libre: ~ 61 cm^2
Δp max. admissible: 0,4 bar
Poids: ~ 1,0 kg

sefco

Filter- Einbau / Strainer- Assembling / Montage du Filtre

4 11366



Temperaturüberwachung an der Pumpe
Temperature control at the pump
Protection thermique de la pompe

Die Pumpe *kann* mit folgenden Fühlern ausgerüstet sein :
The pump *can* be equipped with the following sensors :
La pompe *peut* être équipée des sondes suivantes :

Funktion	**Fühler Typ**	**Wellendichtung Typ**	**Empfohlene Schaltpunkte**
Function	**Sensor type**	**Shaft seal type**	**Recommended set point**
Fonction	**Type de sonde**	**Etanchéité type**	**Réglage recommandé**

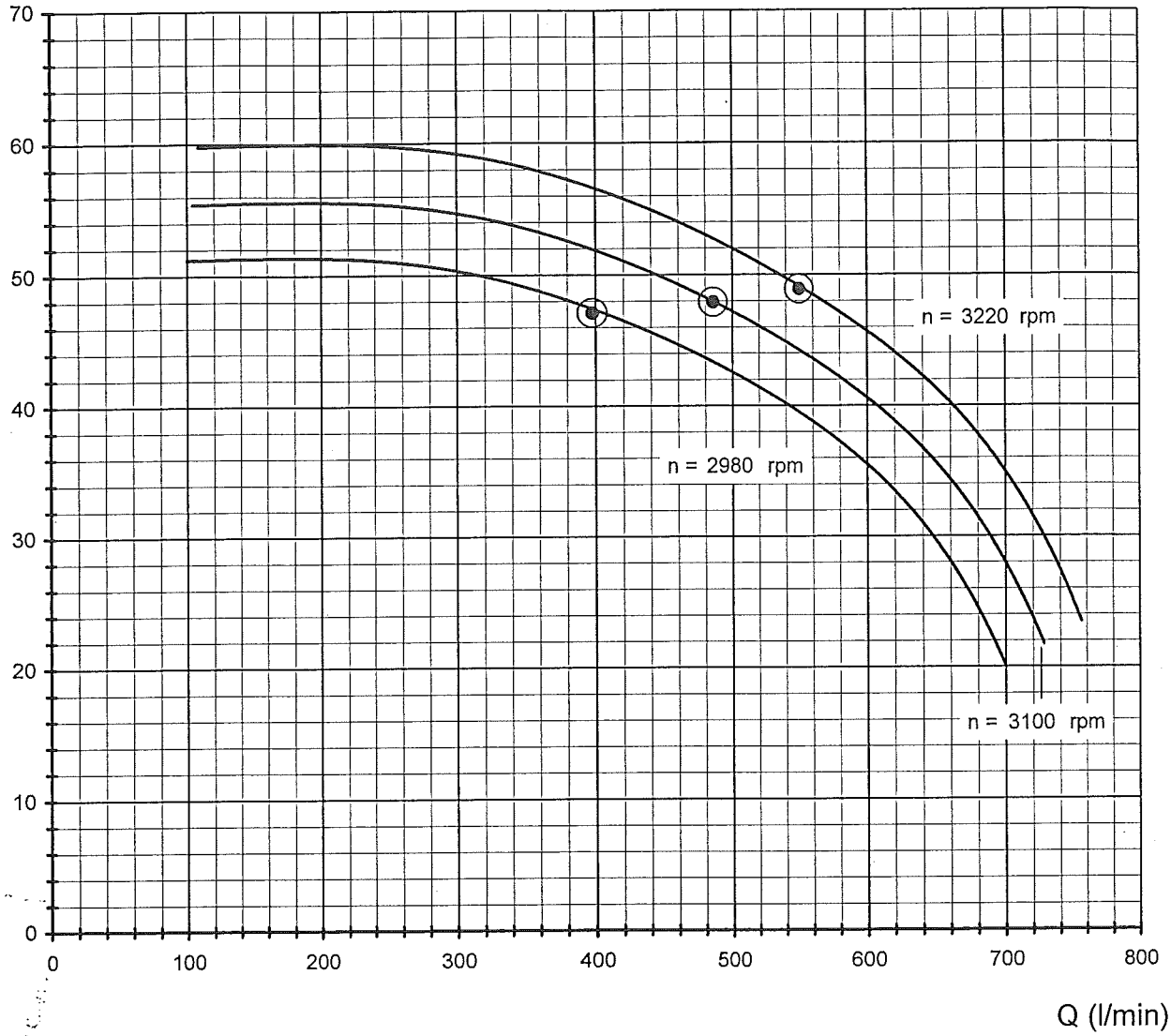
Kaltfahrüberwachung	PT100		-140°C
Cool down survey	RTD		
Contrôle de mise à froid	PT100		

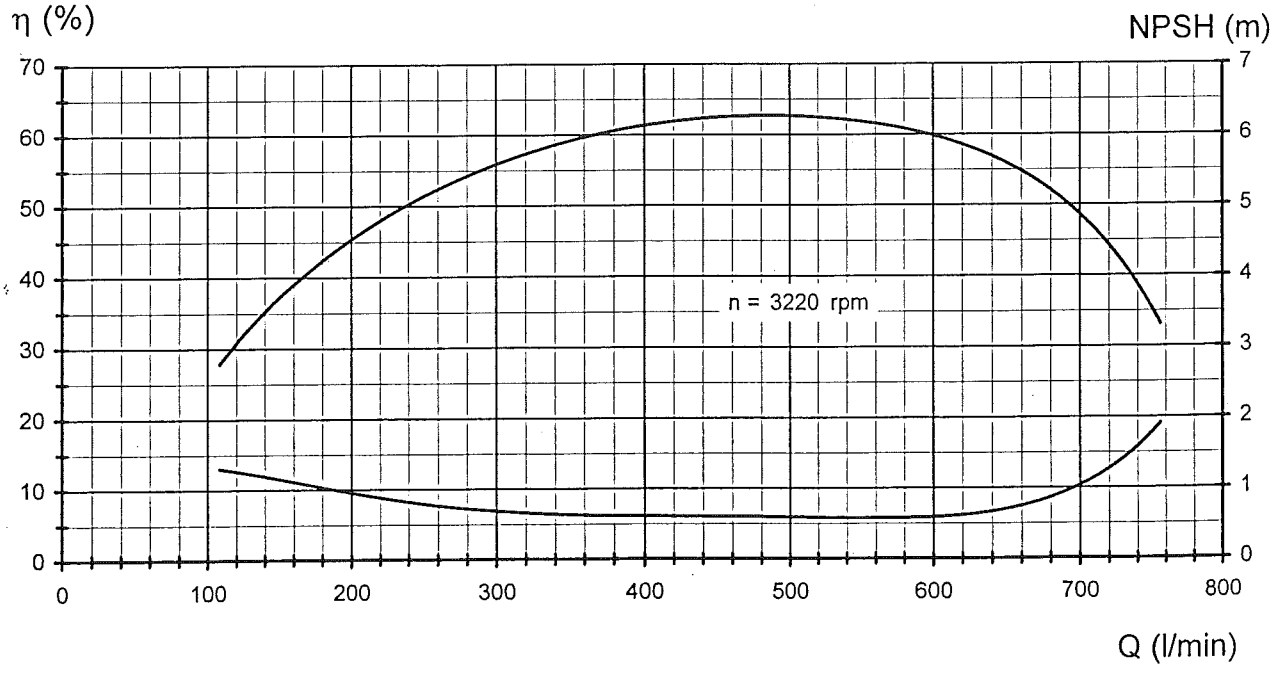
Leckage an der Dichtung	PT100	GRD oder Labyrinth	Alarm, alarme : -130° C Abschalten, shutdown, arrêt : -150° C
Seal leakage detection	RTD	Mechanical or labyrinth	
Détection de fuite à l'étanchéité	PT100	Mécanique ou à labyrinthes	

Leckage an der Dichtung	PT100	GRS (abhebende Dichtung)	Alarm, alarme : -160° C Abschalten, shutdown, arrêt : -180° C
Seal leakage detection	RTD	GRS (gas riding seal)	
Détection de fuite à l'étanchéité	PT100	GRS (à film gazeux)	

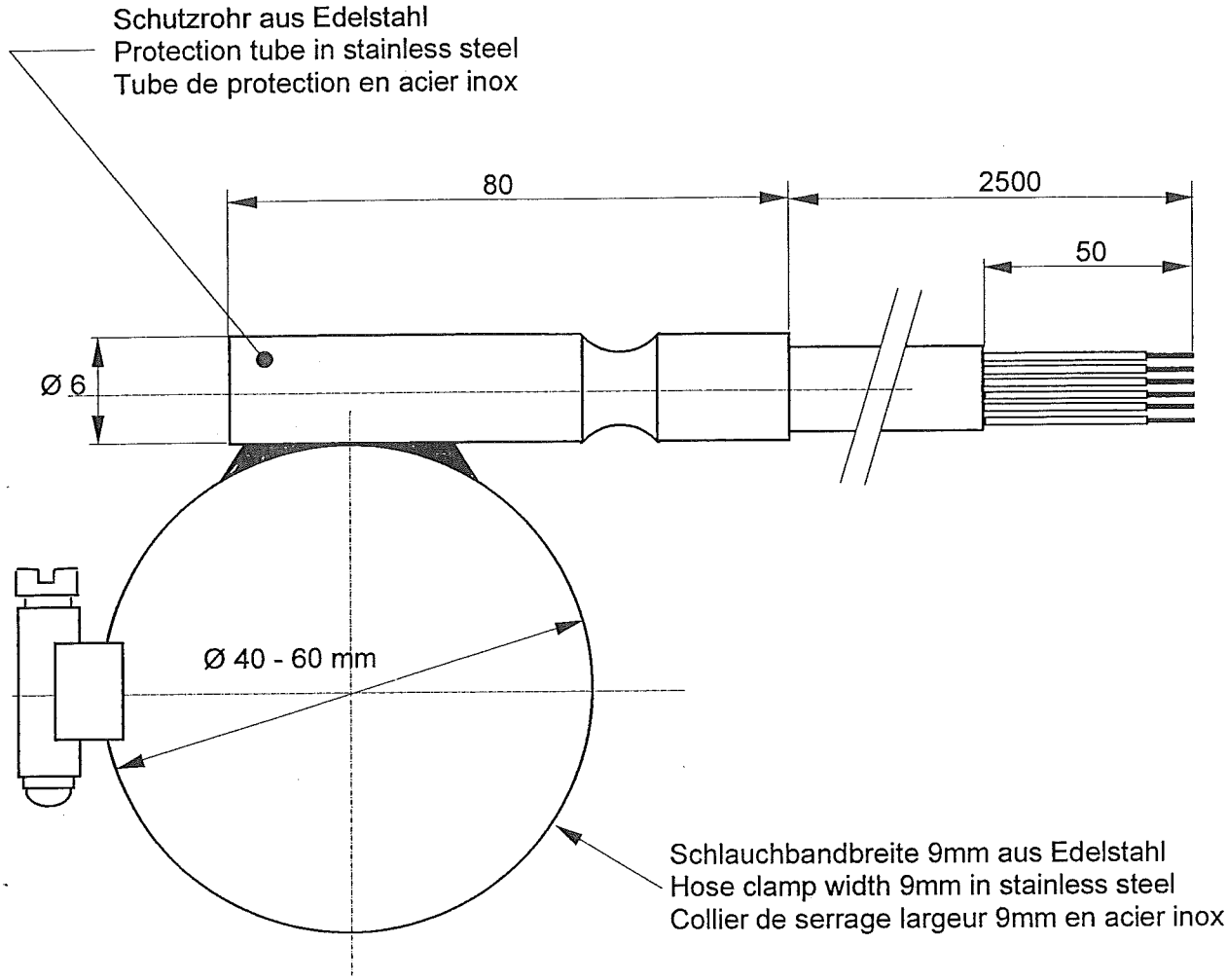
sefco	CL - 19	229-04/1

Impeller ∅ 190 / 6.5 mm with Inducer, Blade-ring
Diffuser 600





Gezeichnet Dessiné	CM
Geprüft Controllé	
	20.08.2004



Typ - Type

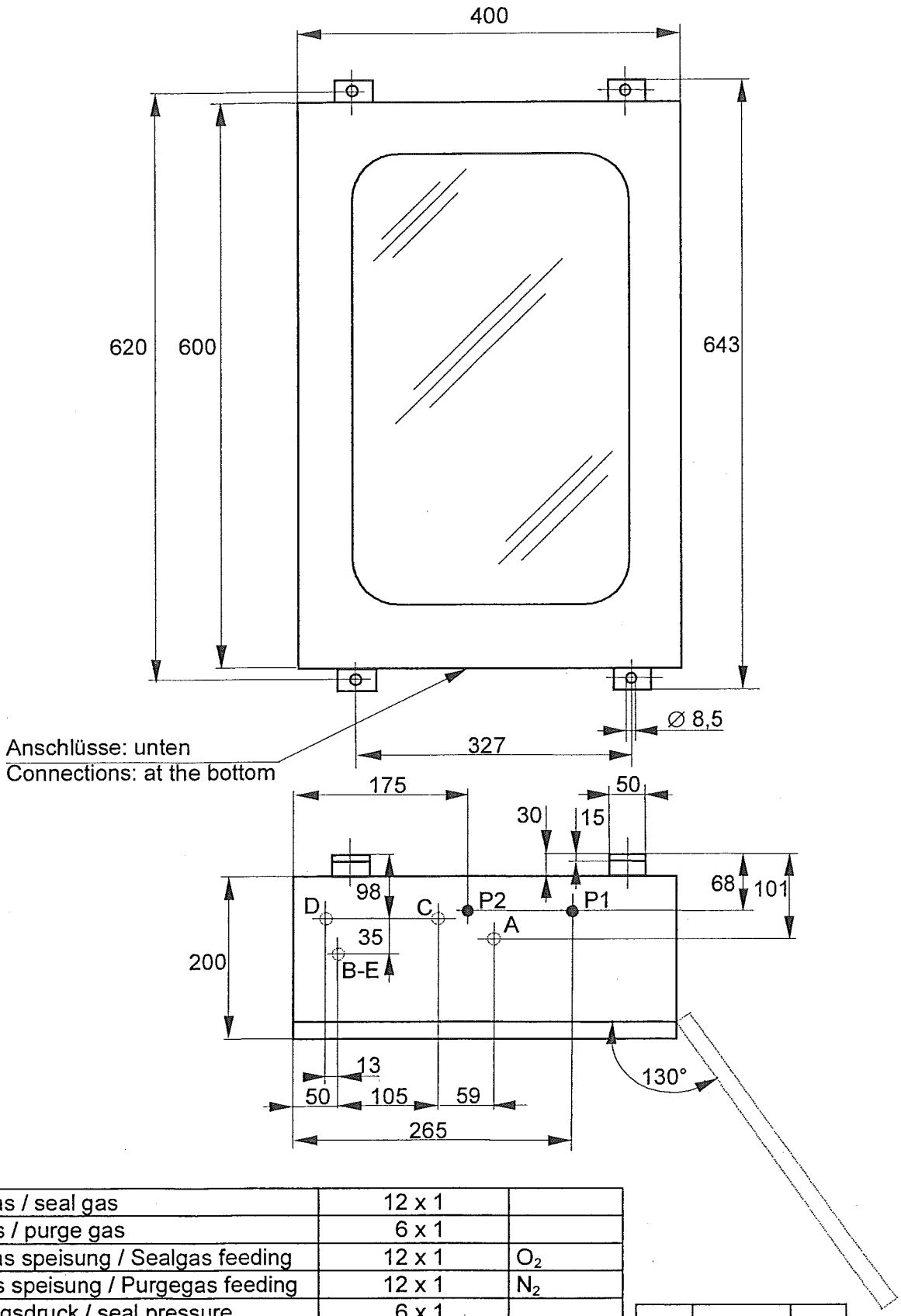
- Widerstandsfühler 2x PT100, 2x 3 Leiter Klasse B mit Schlauchbandbride
- Temperature sensor 2x PT100 (dual RTD's), 2x 3 wires class B with hose clamp
- Sonde de température 2x PT100, 2x 3 conducteurs classe B avec collier de serrage

Temperatur :
Temperature: ± 200°C
Température:

sefco

STEUERSCHRANK LABYRINTHDICHTUNG
CONTROLBOX LABYRINTH- SEAL

4 13161

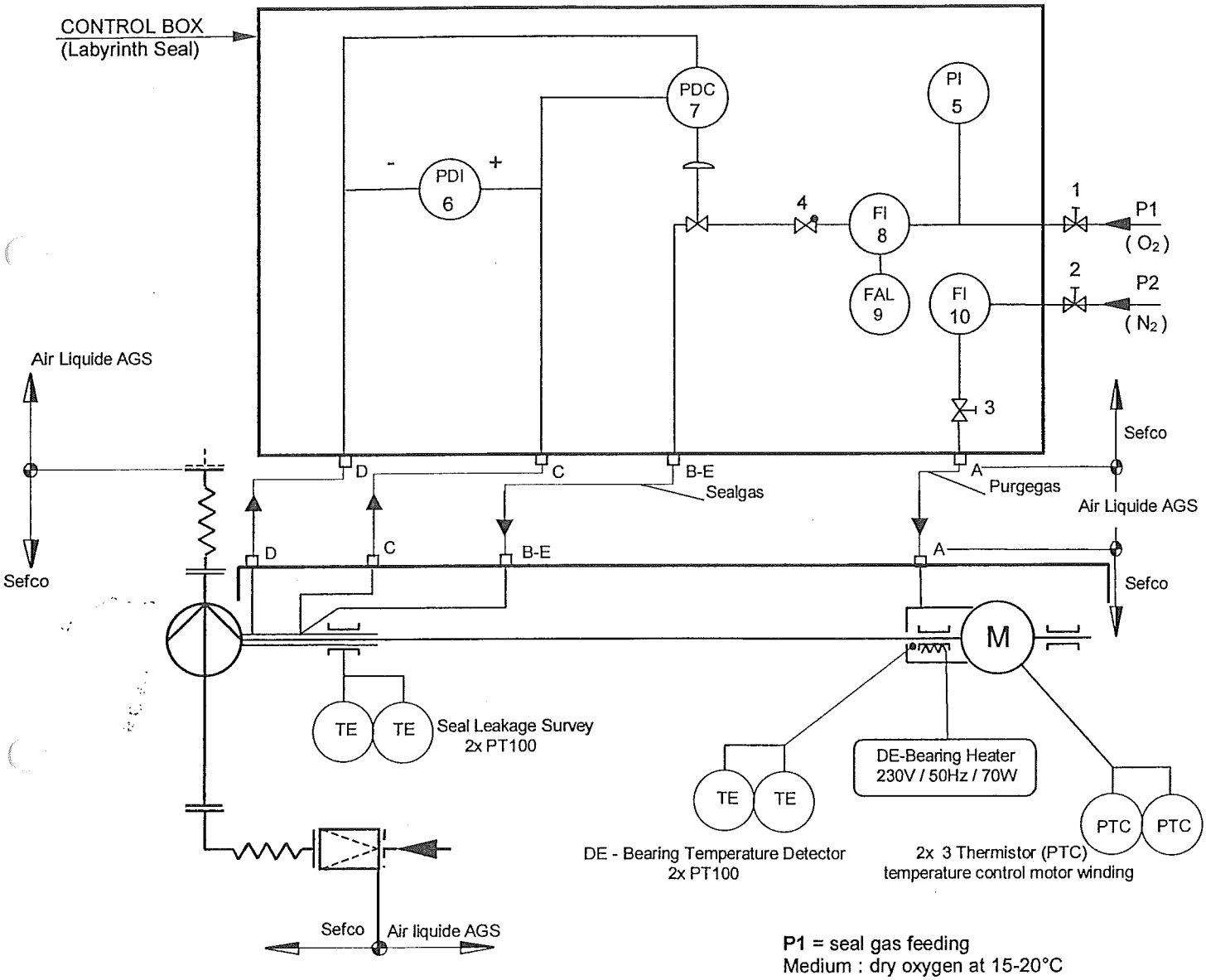


B-E	Sperrgas / seal gas	12 x 1	
A	Spülgas / purge gas	6 x 1	
P1	Sperrgas speisung / Sealgas feeding	12 x 1	O_2
P2	Spülgas speisung / Purgegas feeding	12 x 1	N_2
C	Dichtungsdruck / seal pressure	6 x 1	
D	Referenzdruck / reference pressure	6 x 1	
		Rohr Ø / Tube Ø	

0	27.02.01	MR
Rev.	Date	dwg

Air Liquide AGS GmbH

Order.Nr. : 4500023387
Tag Nr. : **P40100**
Project Name: „ ASU Kosice "



Pos.	Fitting for tube
A	Ø 6 x 1
B-E	Ø 12 x 1
C	Ø 6 x 1
D	Ø 6 x 1
P1 – P2	Ø 12 x 1

P1 = seal gas feeding
Medium : dry oxygen at 15-20°C
Pressure : 4 bar at box inlet

P2 = purge gas feeding
Medium : dry nitrogen at 15-20°C
Pressure : 4 bar at box inlet

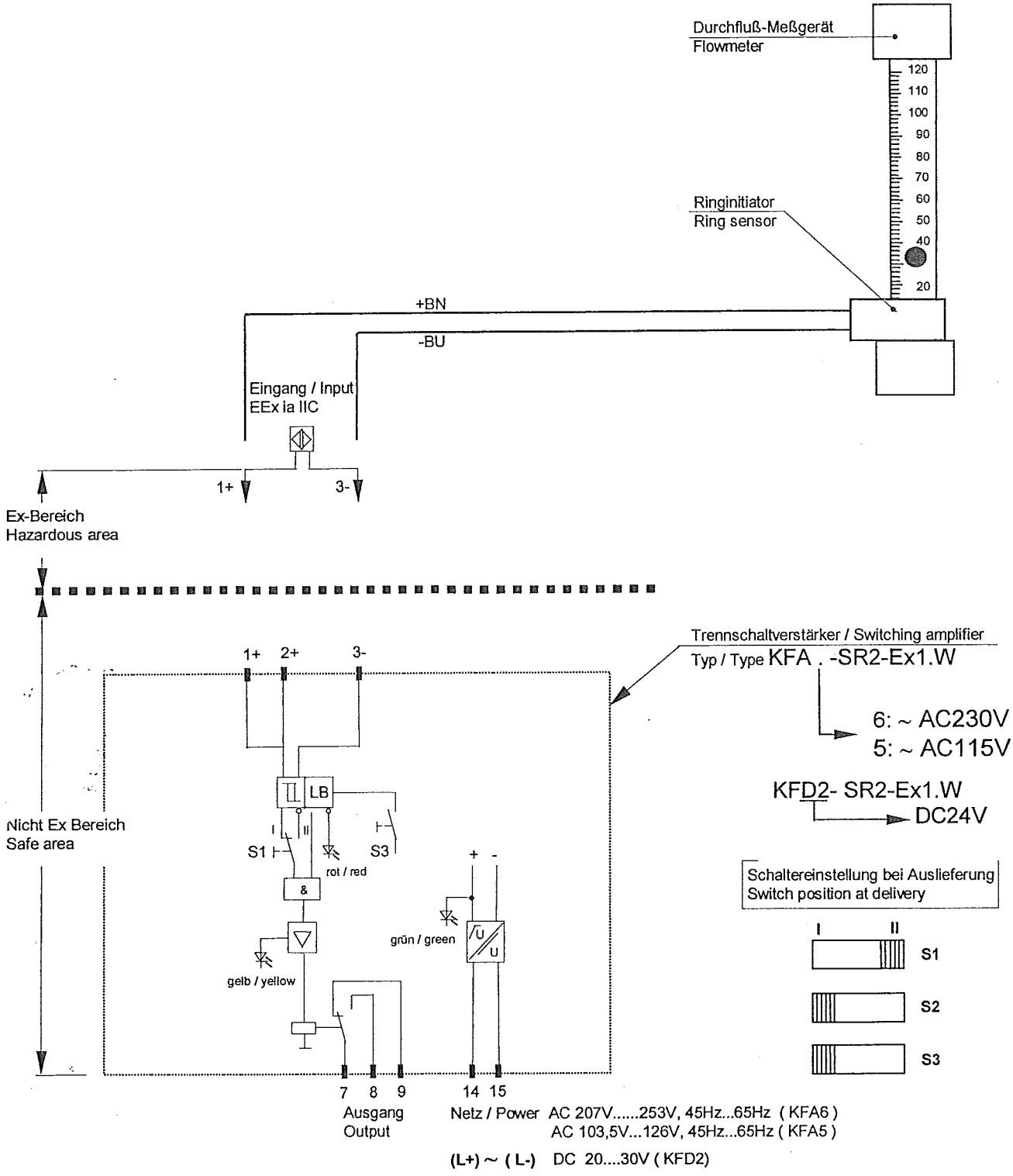
0	26.01.2005	WP	
REV	DATE	DWG	CHECKED

Control Point		No. off	Instruments	Manufacturer	Type	Technical Data	Remarks
P1	1	1	Regulating valve	Serto	SO56121-12-12		O2
P2	2	2	Regulating valve	Serto	SO56121-12-12		N2
	3	1	Regulating valve	Serto	SO55221-6-6		
	4	1	Non-return valve	Serto	SO57321-12		
PI	5	1	Pressure gauge	Wika	111.10.63	0..10 bar	
PDI	6	1	Diff. Pressure gauge	Wika	711.11.100	0....6 bar	
PDC	7	1	Diff. Pressure regulator	Sefco	DP 65		
FI	8	1	Flow-indicator	Vögtlin	V 100.140.19 ov		
FAL	9	1	Ring Sensor	Pepperl-Fuchs	RC15-14-N3Y49839		
		1	Switching amplifier	Pepperl-Fuchs	KFD2-SR2-Ex1 W	24VDC	
FI	10	1	Flow-indicator	Vögtlin	V 100.140.16 ov		

Air Liquide AGS GmbH
Order Nr. : 4500023387
Tag Nr.: **P40100**
Project Name: „ ASU Kosice “

0	17.02.2005	WP		
REV	**Datum**	**Gezeichnet**	**Geprüft**	

Durchflußüberwachung (Sperrgas) - Flow- Control (Seal- gas)



Standard Design

Design and accuracy correspond to normal specifications. This gauge can be used for all liquids and gases under pressure, except those which attack copper alloys, have a high viscosity or are liable to crystallize.

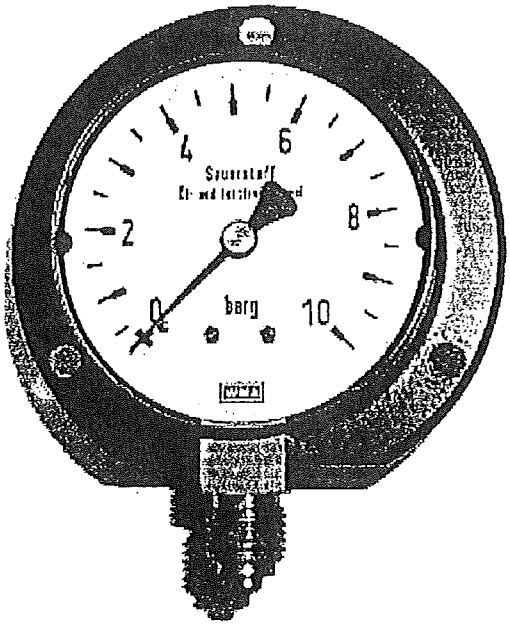
Application

Measurement of positive and negative pressures in the range up to 1000 bar maximum.

Type

Type	*Parts in contact with fluid*	*Type of case*
111.10	Copper alloy	steel with snap-in window

Technical characteristics



Accuracy: ± 1,6% off full scale deflection.

Temperature range

Ambient temperature: -25° up to +60 °C
Fluid temperature: soldered gauge up to +60 °C
welded gauge up to +100 °C

Temperature coefficient of indication (reference temperature +20 °C)

The deviation of the indication is +0,3% per 10 °C of the indicated value for higher temperatures and -0,3% per 10 °C of the indicated value for lower temperatures.
The temperature used for the correction of the indication is the temperature of the measuring system and not
the temperature of the process fluid.

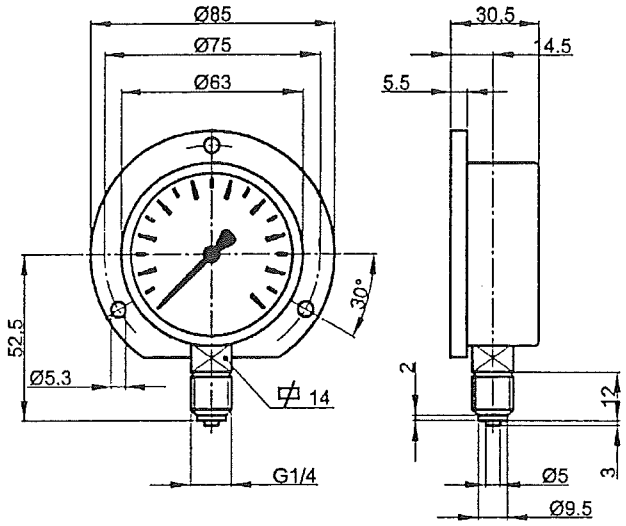
Operating range

75% of full scale reading for static loads
60% of full scale reading for fluctuating loads
Short term peaks to full scale reading permissible

Design features of standard type

Compact measuring system design. This means that connection, tube base, measuring element, movement and dial constitute a functional unit freely mounted in the casing. The plastic window is fixed to the casing by a practical snap-fit bezel.

Type	111.10
Nominal size	63
Design	
Connection	
Brass	X
G 1/4"A, DIN 16288	X
Width across flats 14 mm	X
Bourdon tube	
Copper alloy, soft soldered	
Circular up to 40 bar	X
Coiled above 60 bar	X
Movement	
Brass	X
Dial	
Plastic ABS, white background, black graduations and lettering with Stop pin.	X
Pointer	
Aluminium, black	X
Case	
Steel, black lacquered	X
Window	
Acrylic plastic, domed	
Snap-fit bezel	X



Application

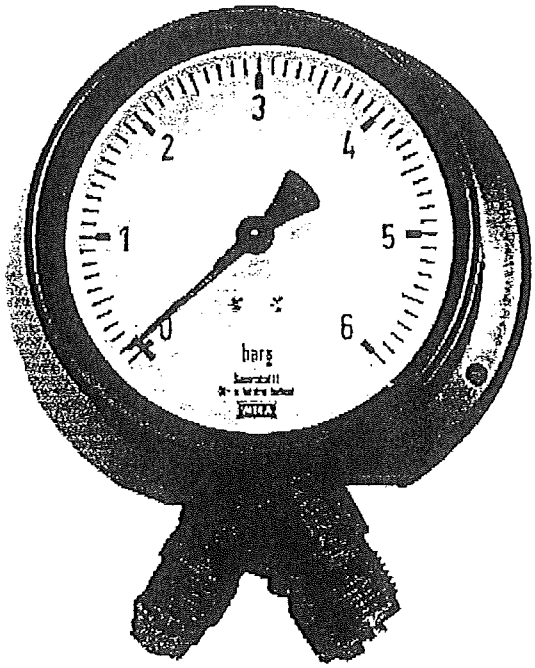
This pressure gauge is suitable with gaseous media and liquids of thin consistency not containing suspended matter. The dial indication facilitates readout of pressure differential as well as of both pressures applied (no vacuum).

Type

Type	*Wetted parts made of*	*Case design*
711.11	Copper alloy	Case and bezel ring black finish steel and V-connector

Measuring principle

The case contains two independently operating bourdon tube pressure elements. Any pressure applied to either one element results in proportional element deflection. Movement and pointer arrangement provides for indication of either one pressure on a 270° scale.



Design

Pressure elements are protected by a rigid case. Pressure element assembly together with dial, pointer and movement are a self contained unit and retained in the case in such a way that any case distortion will not affect measurement. Pressure elements of Cu-alloy are of the circular type. Cu alloy elements are soldered. The gauge window is made of flat instrument glass and retained by a slip-on bezel ring.

Instrument specification

Accuracy: DIN class 1,6.

Operating temperature
Ambient: -25° to +60 °C
Fluid: +60 °C max.

Error caused by temperature deviating from +20 °C

+0,3% each 10 °C increase
-0,3% each 10 °C decrease of scale value indicated.
Actual temperature at pressure element refers, which is not necessarily the temperature of the fluid.

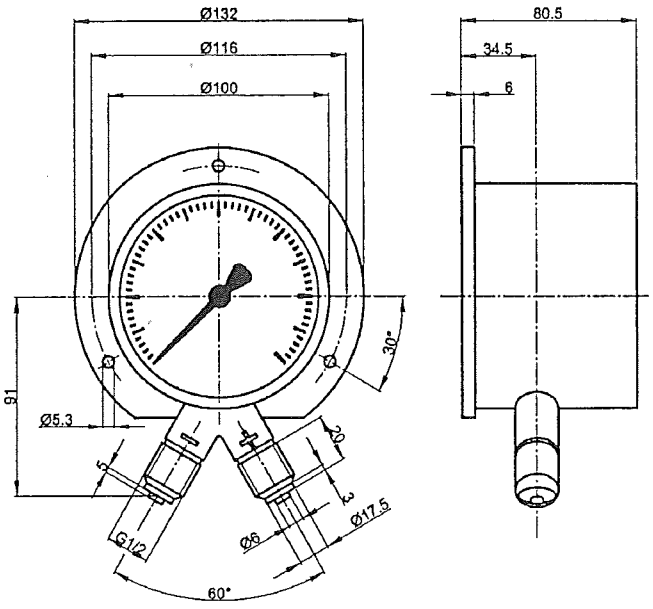
Suitable working pressure

3/4 of max. scale value with steady pressure
2/3 of max. scale value with fluctuating pressure

Maximum static pressures

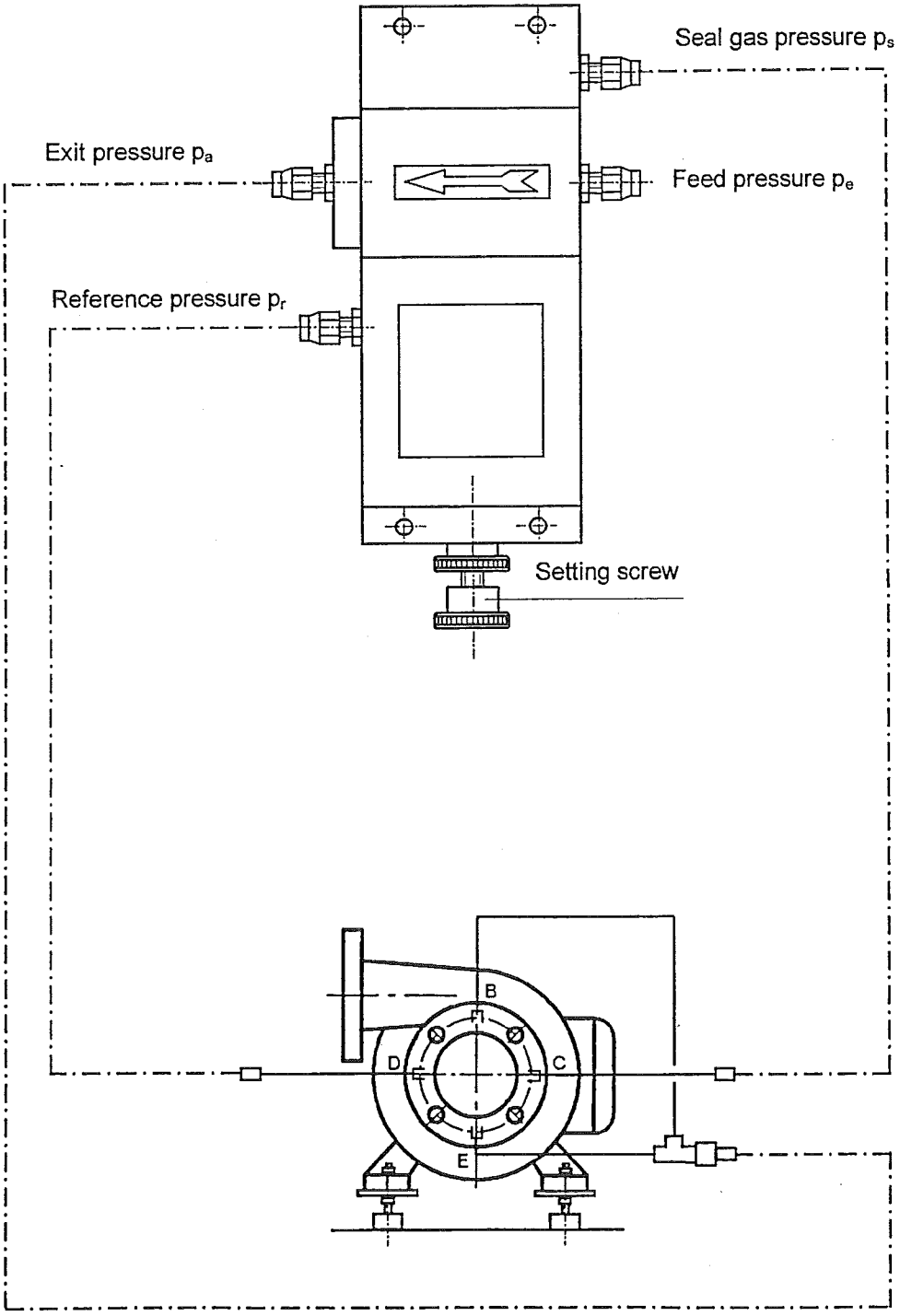
Same as scale range

Type	711.11
Nominal size	100
Design (differential readout, 60° V-connector)	
Connector material Brass Pressure entry 2x G 1/2"A, marked "+" and "-"	X
Pressure element Cu alloy, C-shape, soldered	X
Movement Platelets brass, wear parts argentan	X
Dial Aluminium with black marking	X
Pointer Aluminium black pointer "+" side red pointer "-" side	X
Case Black finish steel	X
Window Flat instrument glass	X
Bezel ring Black finish steel	X
Weather protection DIN 40050 refers	IP33



The differential pressure regulator SEFCO type DP 65 is a component of the seal-/purge gas control-box. It assures the tightness of the liquid gas-centrifugal pump with labyrinth seal and regulates the exit pressure (p_a). The reference pressure (p_r), measured in the pump, as well as the differential pressure (Δp), adjustable with the setting screw are the first reference. The resulting seal gas pressure (p_s) in the labyrinth seal is the second reference.

The differential pressure $\Delta p = p_s - p_r$ is adjustable in a range of approx. - 0,2 to + 0,5 bar ($p_s = p_a$ - piping losses).

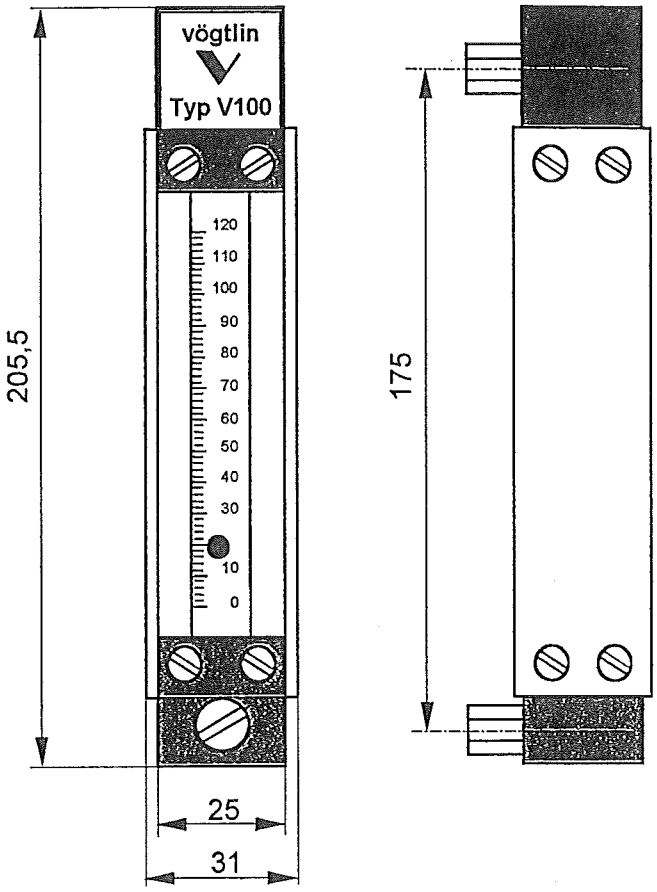


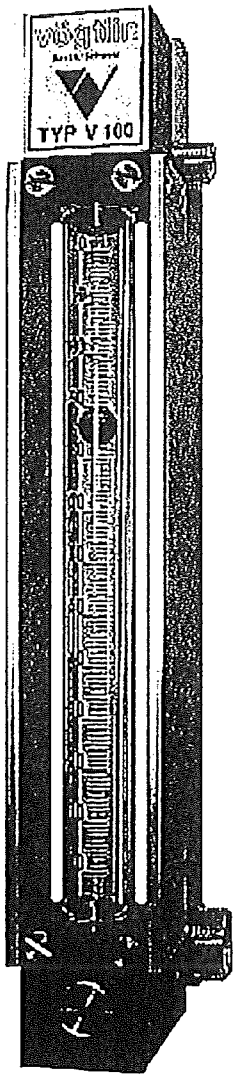
Description

The flowmeter V100 is used to measure small amounts of gas and liquids. The position of the float, in suspense in a calibrated metering tube, shows the momentary flowrate.

Design features

- Rigid Aluminium design for execution A
- Guaranteed stability of the floats
- Standard measuring range of 10:1
- Baked scales with contrasting background
- Simple exchange of the metering tube
- The flowmeter can be equipped with a limit switch. (ring sensor)





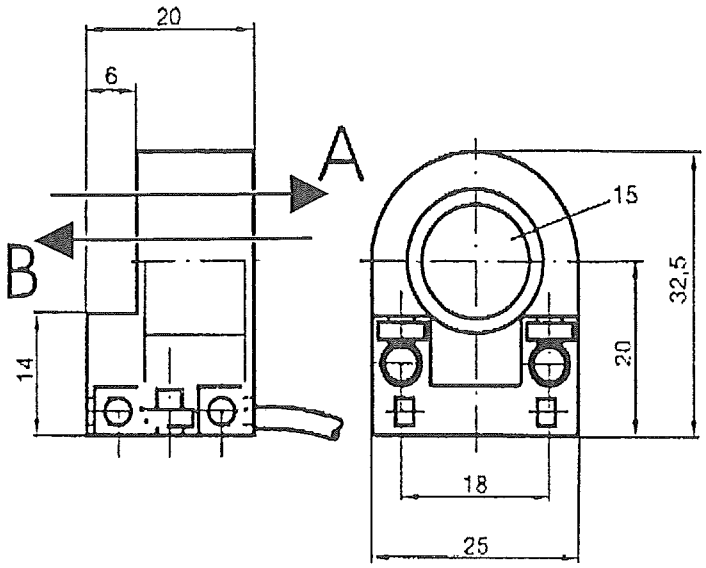
Type	V100-140
Execution	"A" Aluminium
Accuracy	± 2%
Glass-length (mm)	140
Scale-length (mm)	100/120
Fitting length (mm)	175
Float	ball
max. allowable pressure (bar)	16
max. Temperature (°C)	100
Connection	R1/4"
Pressure loss (mbar)	30

Inductive Sensor **Ring Type** **NAMUR** **2-wire**

Bistable

Direction detection

High feed speed
10 m/s

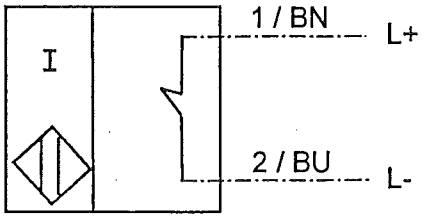


CE

Internal diameter	15 mm
Type	**RC15-14-N3**
Additional designation	**Y49839**
Measuring cylinder	Fe-metal
Diameter	3 mm
Length	4 mm
Nominal voltage	8 V
Current consumption	
Direction A	1 mA
Direction B	3 mA
Feed speed	10 m/s
Self inductance	70 µH
Self capacitance	90 nF
Output indicator	-
EMC to	EN 60947-5-2
In compliance with	EN 50227
Protection to IEC 60529	IP67
Operating temperature	-20 ...70 °C
Connection	2 m, PVC cable
Conductor cross section	0,14 mm^2
Housing material	PBT

Standard symbol, connection

N3



Transformer Isolated Barriers

KF**-SR2-Ex1.W
Output: Relay

- 1-channel
- Control circuit EEx ia IIC
- Reversible mode of operation
- 1 signal output with 1 changeover contact
- EMC acc. to NAMUR NE 21

24 V DC:

KFD2-SR2-Ex1.W

replaces model KFD2-SR-Ex1

115 V AC:

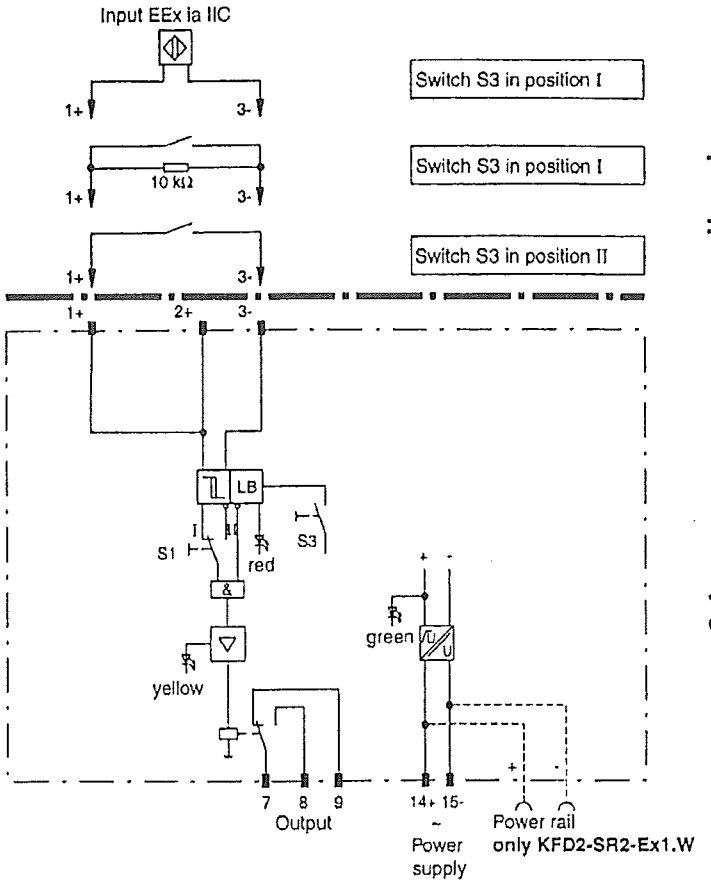
KFA5-SR2-Ex1.W

230 V AC:

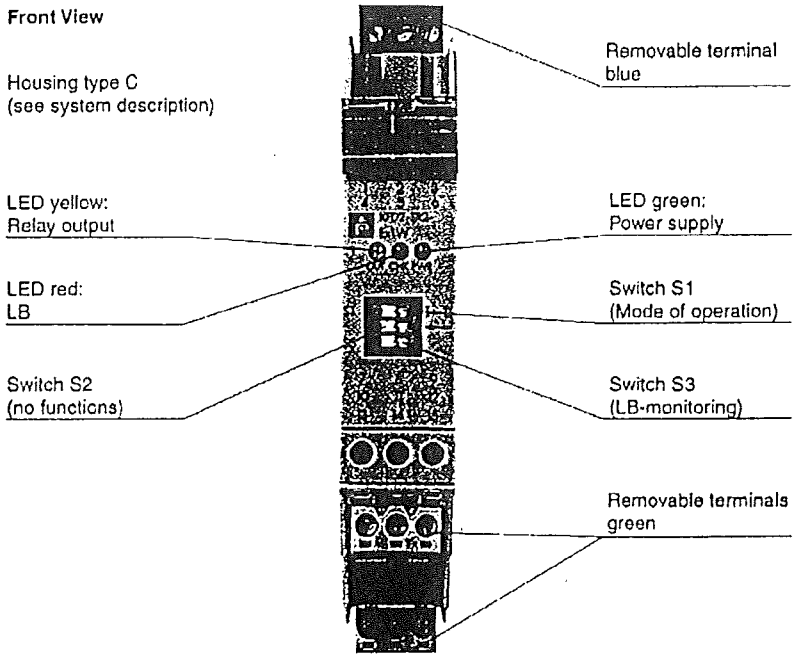
KFA6-SR2-Ex1.W

Function

The transformer isolated barrier transfers digital signals from the hazardous area. Sensors per DIN EN 60947-5-6 (NAMUR) or mechanical contacs may be used as alarms. The control circuit is monitored for lead breakage (LB).
AC units have a low heat build-up due to voltage peak value generation. This switching technique has been patented. The input is safely isolated from the output and the power supply in accordance with DIN EN 50020. The output and power supply are safely isolated from each other in accordance with DIN VDE 106 Section 101.



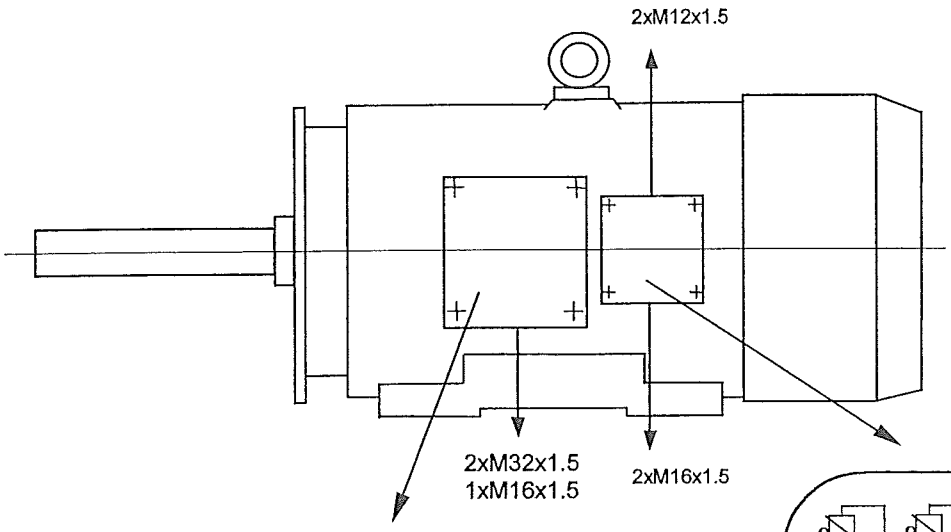
Aufbau



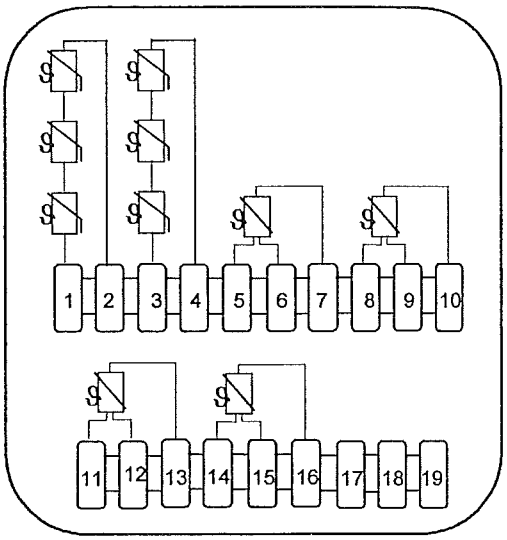
Technische Daten

KF**-SR2-Ex1.W

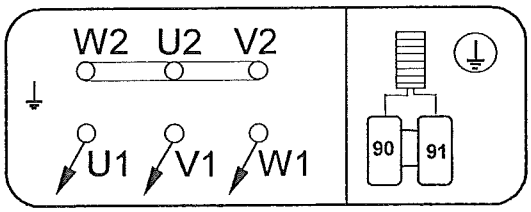
	KFD2-SR2-Ex1.W	KFA5-SR2-Ex1.W	KFA6-SR2-Ex1.W
Power supply			
Connection type	Power Rail or terminals 14+, 15-	terminals 14, 15	terminals 14, 15
Rated operational voltage U_o	20 ... 30 V DC	103.5 ... 126 V AC, 45 ... 65 Hz	207 ... 253 V AC, 45 ... 65 Hz
Safety maximum voltage U_m	40 V DC	126.5 V DC	253 V DC
Ripple	≤ 10 %	-	-
Rated operational current	20 ... 23 mA	-	-
Power consumption	-	≤ 1 W	≤ 1 W
Input (intrinsically safe)			
Connection type	terminals 1+, 3-		
Nominal data	in accordance with IEC 60947-5-6 (NAMUR, DIN 19234); see system description for electrical data		
Input pulse length/Input pulse interval	≥ 20 ms / ≥ 20 ms		
Lead monitoring	breakage J ≤ 0.1 mA		
Details of certificate of conformity			
Certification number	PTB 00 ATEX 2080; for additional certifications refer to the approval list	PTB 00 ATEX 2081; for additional certifications refer to the approval list	PTB 00 ATEX 2081; for additional certifications refer to the approval list
Group, category, ignition protection method	⟨Ex⟩ II (1) G D [EEx ia] IIC	⟨Ex⟩ II (1) G D [EEx ia] IIC	⟨Ex⟩ II (1) G D [EEx ia] IIC
Voltage U_o	10.5 V	10.6 V	10.6 V
Current I_o	13 mA	19.1 mA	19.1 mA
Power P_o	34 mW	51 mW	51 mW
Allowable circuit values			
Ignition protection class, category [EEx ia and EEx ib]			
Explosion group	IIA / IIB / IIC	IIA / IIB / IIC	IIA / IIB / IIC
External capacitance	75 µF / 16.8 µF / 2.41 µF	72 µF / 16.2 µF / 2.32 µF	72 µF / 16.2 µF / 2.32 µF
External inductance	1000 mH / 840 mH / 210 mH	780 mH / 390 mH / 97 mH	780 mH / 390 mH / 97 mH
Output (not intrinsically safe)			
Connection type	terminals 7, 8, 9		
Output	signal; relay		
Contact loading	253 V AC / 2 A / cos φ > 0.7; 40 V DC / 2 A resistive load		
Mechanical life	10^7 switchings		
Energized/De-energized delay	approx. 20 ms / approx. 20 ms		
Transfer characteristics			
Switching frequency	< 10 Hz		
Galvanic isolation			
Input/Output	safe galvanic isolation acc. to EN 50020, voltage peak value 375 V		
Input/Power supply	safe galvanic isolation acc. to EN 50020, voltage peak value 375 V		
Output/Power supply	safe isolation acc. to DIN VDE 0106, design isolation voltage 253 V_{eff}		
Ambient conditions			
Ambient temperature	-20 ... 60 °C (253 ... 333 K)		
Standard conformity			
Input	in accordance with IEC 60947-5-6 (NAMUR, DIN 19234); see system description for electrical data		
Coordination of insulation	accord. to DIN EN 50178		
Galvanic isolation	accord. to DIN EN 50178		
Climatic conditions	accord. to DIN IEC 721		
Electromagnetic compatibility	accord. to EN 50081-2 / EN 50082-2, NAMUR NE 21		
Mechanical specifications			
Mass	approx. 150 g		



Survey (RTD's)



Motor 160 M **Bearing Heater DE**



Y-Connec. 400V / 50Hz / 3 / 11kW | 230V / 50Hz / 1 / 70 W

Wiring-Table

1-2	PTC alarm	Winding	ISO F
3-4	PTC disconnecting	Winding	ISO F
5-6-7 8-9-10	Temperature Detector RTD	Bearing DE	Dual
11-12-13 14-15-16	Temperature Detector RTD	Seal leakage detection	Dual
17-18-19	Spare		
90-91	Bearing heater	Bearing DE	

Air Liquide AGS GmbH
Best.Nr.: 4500023387
Tag Nr.: **P40100**
Project Name: „ ASU Kosice "

! **RTD :** Measuring current: 1 mA
PTC thermistor sensors: Do not apply more than 2.5V!

0	16.02.2005	WP	
REV	DATE	DWG	CHECKED

Temperaturüberwachung E-Motor
Motor temperature control
Protection thermique du moteur

Der Motor *kann* mit folgenden Fühlern ausgerüstet sein :
The motor *can* be equipped with the following sensors :
Le moteur *peut* être équipé des sondes suivantes :

Messstelle	**Fühler Typ**	**Schaltpunkt** Werte können von Hersteller zu Hersteller leicht ändern	**Empfohlene Schaltpunkte** Alarm Zwischenwerte können nach belieben gesetzt werden
Control point	**Sensor type**	**Trip point** Values can change slightly by different manufacturers	**Recommended set point** Alarm points can be set in between upon need
Point de contrôle	**Type de sonde**	**Température de commutation** Ces valeurs peuvent différer légèrement suivant le fabricant du moteur	**Réglage recommandé** Les points d'alarme peuvent être placés au choix entre ces extrêmes

Lager AS	PT100		-40°C .. +120°C
Bearing DE	RTD		
Palier entraînement	PT100		

Lager BS	PTC	max. +120°C	
Bearing NDE	Thermistor		
Palier ventilateur	Thermistor		

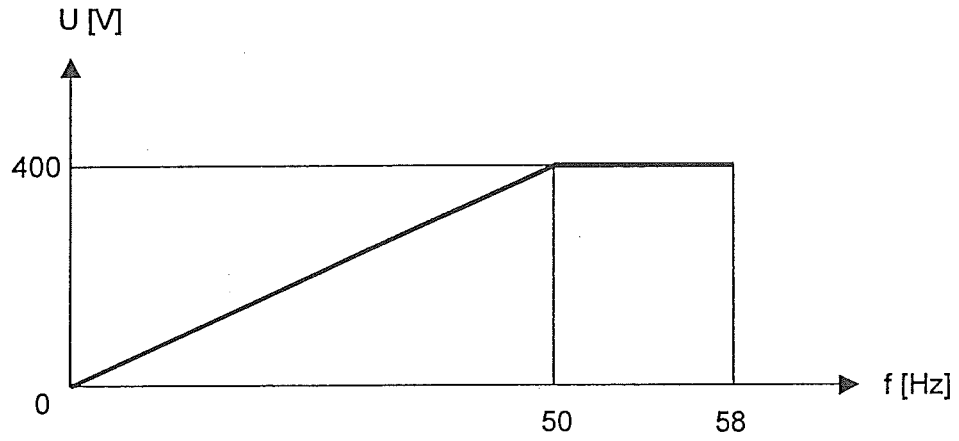
Lager BS	PT100		-40°C .. +120°C
Bearing NDE	RTD		
Palier ventilateur	PT100		

Wicklung	PTC	Isolationsklasse F Alarm : +130°C Abschaltung : +150°C	
Winding	Thermistor	Insulation class F Alarm : +130°C Trip : +150°C	
Bobinage	Thermistor	Isolation svt. F Alarme : +130°C Arrêt : +150°C	

E-Motor 160M - 11 kW

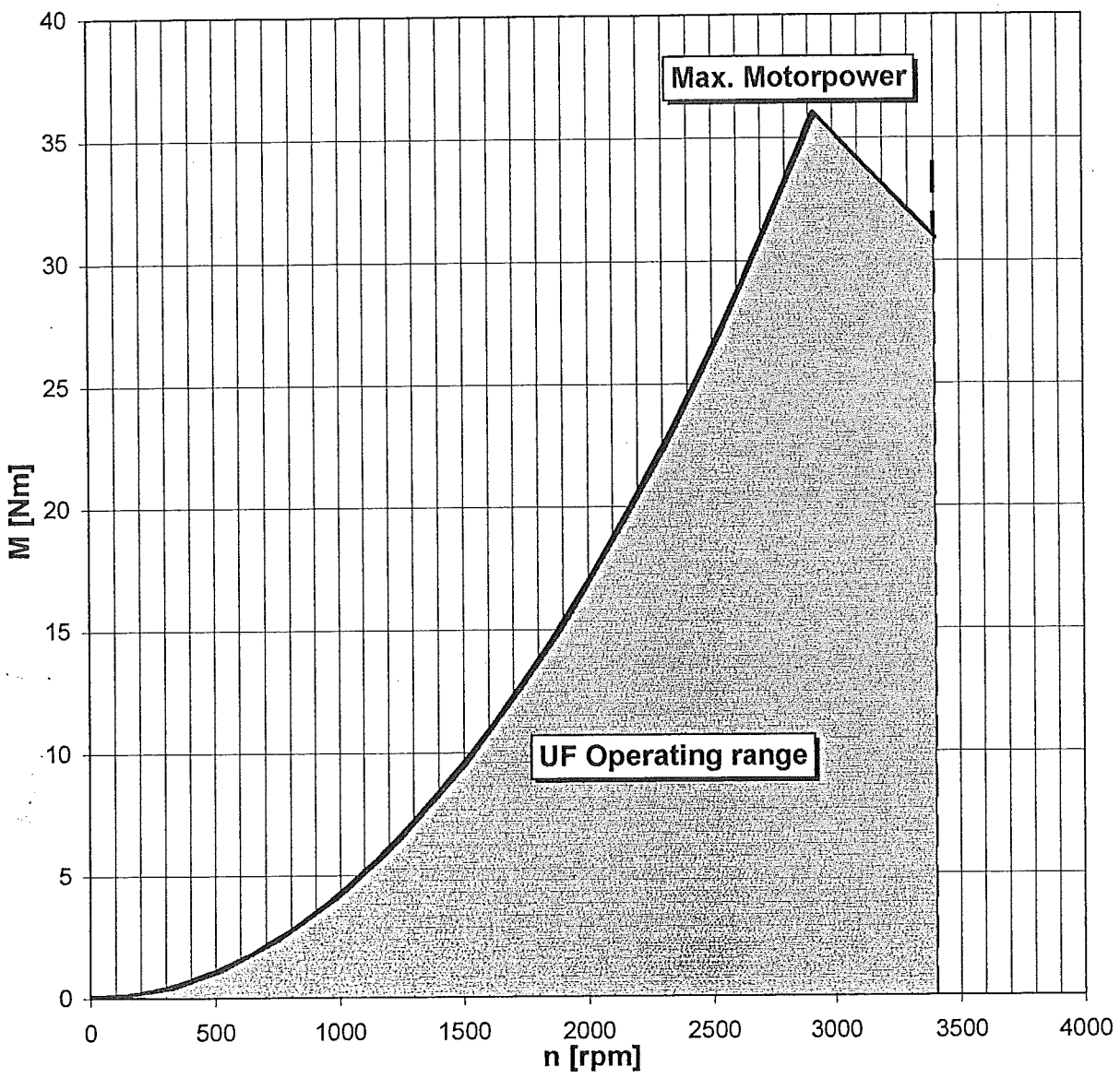
Air Liquide AGS GmbH
Order- Nr. : 4500023387
Tag- Nr. : **P40100**
Project Name: „ ASU Kosice "

Nominal Power	11	[kW]	
Nominal Speed	2920	[min.$^{-1}$]	(Operating range : 2750 – 3400)
Nominal Frequency	50	[Hz]	(Operating range : 47 – 58)
Nominal Voltage	400	[V]	



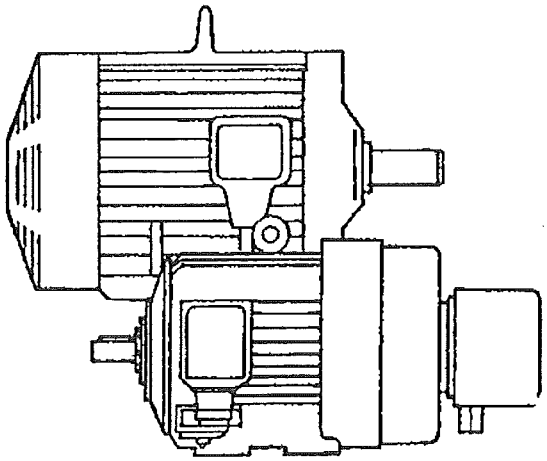
sefco **Torque Curve** 05.040/10

Pump Type **CL-19 / EM-11**	Nominal Power **11 [kW]**	Nominal Speed **2920 [rpm]**
Customer-Ref.	***Air Liquide AGS GmbH*** Order- Nr. : 4500023387 Tag- Nr. : **P40100** Project Name: „ ASU Kosice “	



Treephase Induction Motors
Type DDA/DDG

Mounting & Maintenance



www.halter-motoren.de
e-mail: info@halter-motoren.de

THREEPHASE INDUCTION MOTORS TYPE DDA/DDG

- MOUNTING & MAINTENANCE -

TABLE OF CONTENTS page

1. GENERAL INFORMATION

This manual concerns normal three phase induction motors with an output varying from small to middle size; they are externally cooled, totally enclosed, supplied in a cast iron frame and provided with ball bearings or roller bearings lubricated with grease.

2. DELIVERY

After receipt, remove the package material if any and mind the parts that have been delivered loose. In the case of unpacked motors, the glands are often put in the terminal box to protect them against damage.

Check the motor to see whether transport damage has occurred.
You should be able to rotate the shaft easily and smoothly with the hand.

Compare the details on the rating plate with those of the power network and with the requirements of the motor.

3. MOUNTING

The motor must be fixed on a stable, clean and flat foundation with good fitting foundation bolts, using washers.
Never mount a motor manufactured for a horizontal mounting on a surface with an angle of inclination of more than 15 degrees without consulting the supplier in advance.

Foot & flange motors always have to be mounted in such a way that the drain holes, if any, are situated at the bottom, otherwise you run the risk that moisture has condensed into the motor and cannot be drained off. To this end you need to remove the drain plugs.

Under no circumstance must the free flow of air be obstructed to the cooling fan or the motor will overheat.
This has also to be borne in mind when you are mounting motors in enclosed spaces of small size.
The ambient temperature must not exceed 40 degrees centigrade, unless otherwise agreed upon at the time of ordering.

4. COUPLING

4.1 Direct coupling

The motor and driven shafts must be accurately aligned. In case of a flexible coupling, the manufacturers distance between the parts to be coupled must be adhered to, also the degree of misalignment must be within the makers tolerance. We do not recommend using solid couplings.

4.2 Indirect coupling

4.2.1. Flat or V Belts

Mount the motor on slide rails in order to adjust belt tension.
The belt pulley has to be fitted hard up the shoulder of the shaft. The pulley center line should be within the shaft center line. Use correctly sized belts with a correct profile and in sufficient numbers to drive without slip and undue tension. Align both pulleys accurately in such a way that the center of both pulleys are in line.
Multi V belt drives need to be matched sets.

A belt pulley, which is either too small or too wide, or too high, a tension on the belt may damage the bearing or cause a shaft break.
In case of doubt, consult the supplier.

4.2.2. Spur Gear Drives

The motor and the driven machine have to be positioned in such a way that the two gears mesh correctly. The motor should then be fixed with dowels.

4.3. Shaft couplings and pulleys etc.

Remove the corrosion protection from the shaft extension and the coupling elements. The coupling parts, belt pulleys and gear wheels need to be dynamically balanced and fit easily on the shaft and to be provided with good fitting keyway.

In the factory the rotor has already been dynamically balanced including a half key in the shaft.

The dimension and the tolerances of the shaft extension and the key are indicated on the motor dimension sheet.

Assembling the coupling elements has to been done with great care. Careless handling may damage the bearings, shaft or end shields.

Do not file or emery the shaft to achieve a fit!

hen fitting pulleys couplings or bearings, we recommend using heat to elements; therefore the part to be mounted has to be heated till ± 80 degrees above the ambient temperature.

A large washer and set screw can be useful for pushing on pulleys using the tapped hole in the shaft. Only use proper tools for removing the above mentioned parts e.g. pulley drawers.

5. ELECTRICAL CONNECTION

5.1. General information

On delivery the motor will rotate clockwise looking at the drive when the phases L1, L2 and L3 are connected respectively to the connection terminals U1, U2 and U3.
Exchanging any two-phase lines can change the direction of rotation.
When a motor is only suited for one direction of rotation, it is indicated with an arrow on the motor fan cowl.

Connecting cables must conform to IEE regulations, as must earthing requirements.
Line fuses only protect the cables in case of short–circuiting and do not constitute a safeguard against the overheating of the winding caused by overload. Therefore it is recommended that a motor starter and overload is fitted, giving single phasing and overload protection.

5.2. Circuit

Normally our motors are provided with a terminal box with six connections, to which six leads from the winding are connected either in a delta connection or in a star connection by means of connection links.

Usually two voltages are indicated on the rating–plate of these motors, which means that the motor can be connected to a circuit having one of these voltages.
If the mains voltage is corresponding with the lowest indicated voltage, the winding has to be connected in delta connection (see figure 1); if it is corresponding with the highest indicated voltage, the winding has to be connected in star connection (see figure 2).

A motor with e.g. 230/400 V on its rating–plate is suited to be switched on directly, on a circuit with a voltage of 230 V between phases with the winding connected in a delta connection, or on a circuit with a voltage of 400 V with the winding connected in a star connection.

But if the motor is switched on with a star–delta starter the motor is only suited for a mains voltage on the rating-plate, this is the delta voltage. In this case, the connection strips on the terminal box have to be removed when the motor is connected; the star and delta connection will be made successively in the starter during the run up.
If only one voltage is indicated on the rating–plate together with the delta sign, the motor can be switched on directly at the indicated voltage or with a star/delta starter.

Pole change motors (for two or more speeds) are connected according to a diagram sent together with the motor.

6. PUTTING INTO SERVICE

Before putting a motor into service, one should check especially when the motor has not been used for a long time that the insulation resistance of the winding is sufficient. The insulation resistance has to be at least 10 meg/ohms on a 1000V megger.
If the insulation resistance is not high enough, the motor has to be dried out and revarnished or rewound.
Check all connections and adjust the thermal protection units to the correct current. Switch the motor on in a no load state to determine the direction of rotation. Load the motor gradually and check whether it runs without vibration.

The motor can be used under deviation of the main voltage ± 5% or frequency of max. ± 2% compared to the nominal frequency or nominal voltage, in compliance with the international regulations for electric machines.

7. MAINTENANCE

The totally enclosed and fan cooled three phase squirrel cage induction motors require very little maintenance.
Nevertheless it is recommended to check the motor regularly in order to prevent a breakdown caused by dust, moisture, vibrations, too much or too little greasing.

7.1. Dust

The outer parts of the totally enclosed motors, especially the cooling ribs or cooling channels, have to be kept as clean as possible in order not to obstruct the cooling air from the fan extracting the heat from the motor frame.

7.2. Moisture

Motors, which are not often run, should be started from time to time to prevent moisture affecting the windings in the long term.

7.3. Wear & vibration

To prevent abnormal wear & vibration, one should:
a. take care that the tension of the belt or the chain is not too high;
b. check whether the mounting of directly coupled machines is correct;
c. Check whether the foundation bolts the bolts to fasten the motor and the slide rails are tight.

7.4. Greasing

Before they leave the factory, the bearings of the HALTER Motors are filled with a high quality Lithium base grease.

The sizes 56 up to and including 250 are provided with shielded/sealed bearings (ZZ-C3), witch have been filled with life-time grease by the manufacture of the bearings.

Motors with sealed bearings and no re-lubrication system require no maintenance other than checking for noise & temperature during their lifetime.
Sizes 280 up to and including 400, has been provided with a permanent lubrication system containing a grease valve.
The lubrication must take place when the machine is running.
The old grease is ejected from the grease valve thus maintaining the correct level and avoiding overfilling which would be harmful.

7.5. Replacement of ball or roller-bearings

When a bearing has to be replaced, the old bearing has to be removed from the shaft with proper tools in order not to damage the shaft. Thereupon the bearing location on the shaft has to be cleaned and checked thoroughly.

To fit a new bearing correctly, heat to 80 – 90 degrees centigrade with an electric induction heater, then slip quickly onto the shaft up to the stop. In the case of a roller bearing only fit the inner race in this manner.

A suitable sleeve may be used to help by tapping gently to seat the bearing home. Note that under no circumstances must a bearing be driven home cold with excess force. We must also stress that pressure must not be applied to the outer race of a ball bearing.

Do not mount the end shield until the bearing has cooled down.

8. Bearing type and bearing inside diameter

! Only for standard motors

HALTER Motor type	Poles	type of bearing Driven end	Non Driven end	Bearing inside diameter(mm)
DDA-56	2/4	6201 ZZ C3	6201 ZZ C3	12/12
DDA-63	2/4	6202 ZZ C3	6202 ZZ C3	15/15
DDA-71	2/4/6	6203 ZZ C3	6202 ZZ C3	17/15
DDA/DDG-80	2/4/6/8	6204 ZZ / 6204 ZZ C3	6204 ZZ / 6203 ZZ C3	20/20/20/17
DDA/DDG-90	2/4/6/8	6205 ZZ / 6205 ZZ C3	6205 ZZ / 6204 ZZ C3	25/25/25/20
DDA/DDG-100	2/4/6/8	6206 ZZ / 6206 ZZ C3	6206 ZZ / 6206 ZZ C3	30/30/30/30
DDA/DDG-112	2/4/6/8	6306 ZZ / 6306 ZZ C3	6306 ZZ / 6306 ZZ C3	30/30/30/30
DDA/DDG-132	2/4/6/8	6308 ZZ / 6308 ZZ C3	6308 ZZ / 6308 ZZ C3	40/40/40/40
DDG-160	2/4/6/8	6309 ZZ C3	6309 ZZ C3	45/45
DDG-180	2/4/6/8	6311 ZZ C3	6311 ZZ C3	55/55
DDG-200	2/4/6/8	6312 ZZ C3	6312 ZZ C3	60/60
DDG-225	2/4/6/8	6313 ZZ C3	6313 ZZ C3	65/65
DDG-250	2/4/6/8	6314 ZZ C3	6314 ZZ C3	70/70
DDG-280	2	6314 C3	6314 C3	70/70
DDG-280	4/6/8	6317 C3	6317 C3	85/85
DDG-315	2	6317 C3	6317 C3	85/85
DDG-315	4/6/8	6319 C3	6319 C3	95/95
DDG-355	2	NU317	6317 C3	85/85
DDG-355	4/6/8	NU322	6320 C3	110/100
DDG-400	4/6/8	NU326	6326 C3	130/130

Figure 1

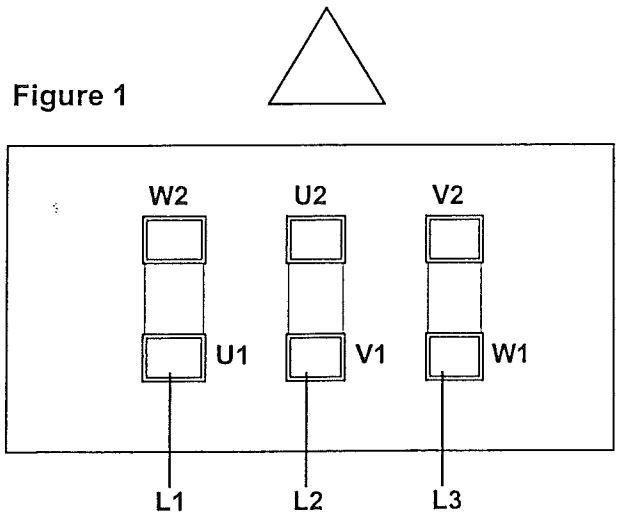
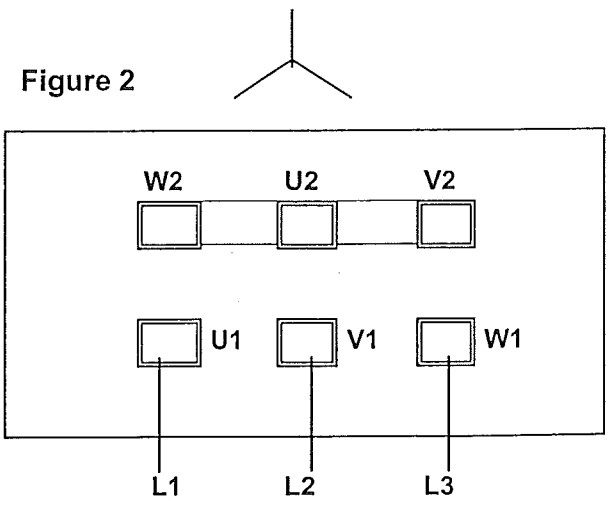


Figure 2



9 Grease-interval Bearings

By the term "greasing interval" we mean the number of working hours after which the bearing lubricant has to be replaced.

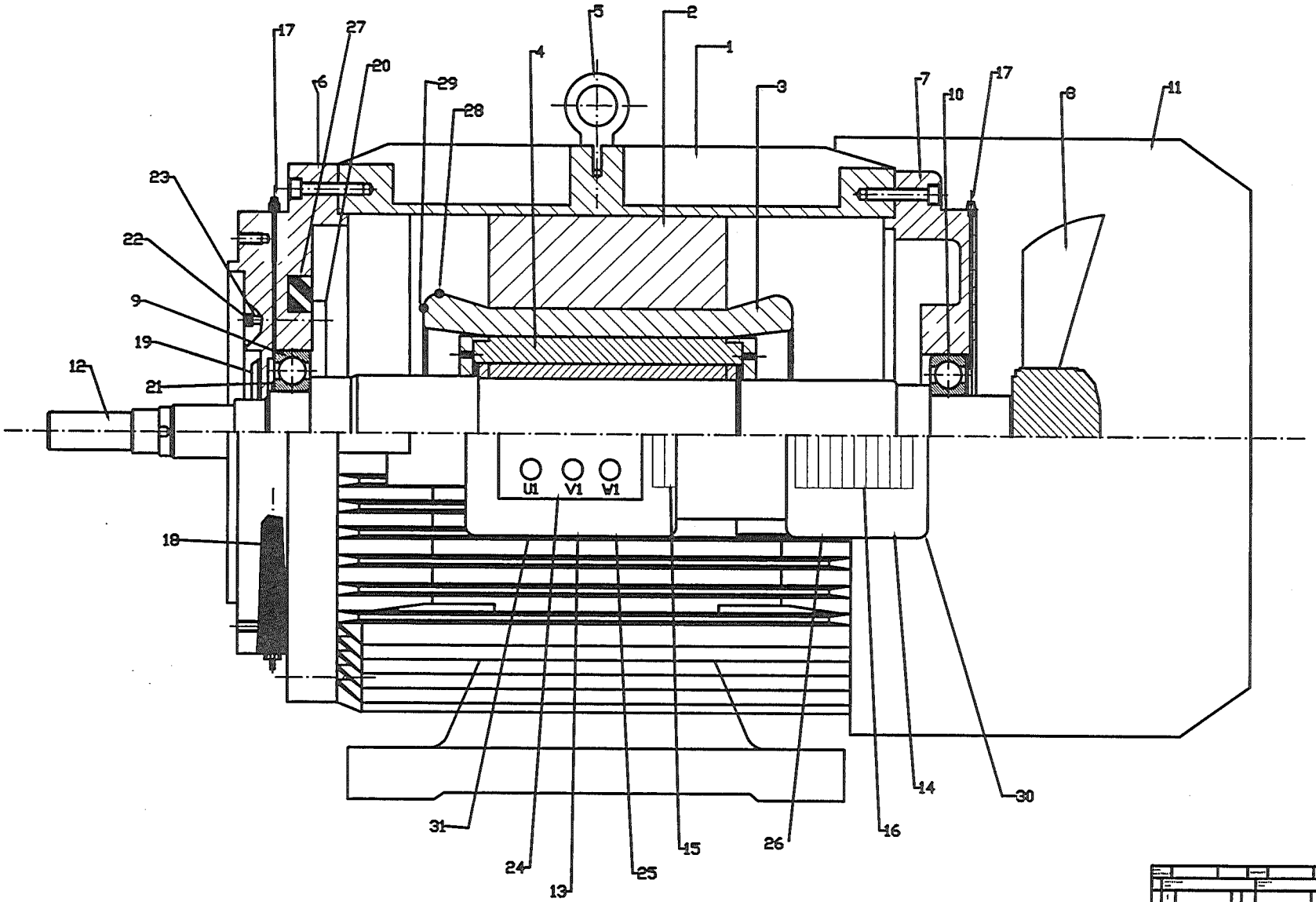
Electric motors have such a wide range of application that they must cope with many adverse conditions as for instance dust, moisture, vibration, temperature, chemicals, marine atmosphere and of course, the mounting position and loading of the driven machine.
Generally we can say lubrication life is a product of time, speed and the bearing size. Due to the impact of all these factors, it is practically impossible to determine any exact values that are valid under all circumstances. Nevertheless it is necessary to provide at least some guidelines concerning greasing to the user.

Under normal load and environmental conditions the quality of the grease ensures proper operation of the motor for about 10000 service hours with 2-pole designs and 20000 service hours with multi pole designs. If not otherwise agreed upon the grease need not be refilled during this period. Nevertheless the condition of the grease filling should be occasionally checked also within the said lubricating intervals.
The stated service hours are only current under operation with rated speed. For relubrication thoroughly clean the bearings with a suitable solvent and use the same or substitute grades specified by the motor manufacturer. Bear in mind, however, that the bearings should be filled only up to about 2/3 of their free space as a complete filling of the bearings and bearing covers results in an increased bearing temperature and therefore in increased wear. For bearings with relubricating facility regrease at the grease fitting with the motor running according to the grease amount required for the motor in case. The relubrication intervals should be looked up in the following table:

A chemically aggressive environment, extreme moistness, strong vibrations, high or low ambient temperatures are not normal circumstances and such conditions must be taken into account.

Motortype	Bearing	Grease	Regreasing	Amount
DDG 160 MB 2	1 x 6310 Z P6 1 x 6309 Z P6	Klüber Isoflex Alltime SL 2	3000 h 3500 h	11 – 13,5 g 9 – 11 g

Motor Type:	DDG 160 MA2
Customer:	Sefco AG
Motor – No:	05038543
Output Power:	11,0 Kw
Speed:	2935 min/1
Voltage:	230 / 400 V
Frequency:	50 Hz
Full - load power factor:	0,90
Connection:	Star
Rated current at 230 / 400 V	34,5 / 19,9 A
Full – load efficiency	88,8
Protection class	IP 55
Insulation class	F to be off use B
Operating mode	S1 / S9
Constuction type	IMB 34
Weight	107 kg


17
27
6
20
29
28
5
2
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10
17
8
11
23
22
9
19
21
12
U1
V1
W1
18
31
24
13
25
15
26
16
14
30

Motor – No. 05038543

DDG 160 MA 2

Spare - List

Pos.	indication	marking	pieces	Supplier/norm
1	Stator – frame	DDG 160 MA2	1	Halter – Germany
2	Stator	DDG 160 MA2	1	Halter – Germany
3	Winding	DDG 160 MA2	1	Halter – Germany
4	Rotor	DDG 160 MA2	1	Halter – Germany
5	Eye – bolt	M12	1	DIN 580
6	Drive – end –shield	03 / 2494 - 2	1	B14 / 200
7	None – drive-end shield	DDG 160 MA2	1	LS – BS
8	Fan	DDG 160 MA2	1	Halter – Germany
9	Drive-end-bearing	6310 Z – P6 CN	1	Halter – Germany
10	None-drive-end-bearing	6309 Z – P6 CN	1	Halter – Germany
11	Fan cowl	DDG 160 L2	1	Halter – Germany
12	Shaft	05 / 2773 - 3	1	1.4057 / C45
13	Terminal box	DDG 160 MA2	1	Halter – Germany
14	Terminal box survey	DE 132	1	Halter – Germany
15	Clip Bearing Heater	AKZ 4	2	Weidmüller Germany
16	Clip survey	AKZ 4	19	Weidmüller Germany
17	Lubrication nipple	M6	2	H1
18	Temperature detector	PT100 Duplex	1	Halter – Germany
19	End play setting washer	RB 50	1	Halter – Germany
20	Drive end inner bearing cap	03 / 2473 - 3	1	Halter – Germany
21	Safeguarding Ring	A 50	1	DIN 471
22	Screw	M6 x 70	4	DIN 912
23	Screw Seal	TM 106	4	Halter – Germany
24	Terminal board	DDG 160 MA2	1	Halter – Germany
25	Cable gland	M32 x 1,5	2	PVC
26	Cable gland	M16 x 1,5	2	PVC
27	Bearing Heater	70W, 50Hz.	1	Halter - Germany
28	Temperature detector	155°	3	Halter – Germany
29	Temperature detector	130°	3	Halter – Germany
30	Cable gland	M12 x 1,5	2	PVC
31	Cable gland	M16 x 1,5	1	PVC

Certificates

sefco — Delivery Certificate

Ref. Nr.: **05.040/1A**

Customer:	Air Liquide AGS GmbH - 4500023387 - ASU Košice - K70101		P40100
Pump Type:	CL-19 / EM-11		
Motor:	Manufacture : Halter	Type: DDG160MA2	Nr.: 05038543
	P: 11 [KW]	U: Y 400 [V]	I: 19,9 [A]
	$n_{,range}$: 2750-3400	/ $f_{:range}$: 47-58 [Hz]	$f_{:field\ weakening\ point}$: 50 [Hz]
Pressure Test (EN 13275:2000/§5.2.2)	Hydraulic pressure test of pump casing completed at 60 bar for 5 min.		
	Date: 18.01.05	Signature: CP	
Degreasing (EN 12300:1999)	Pump cold end has been degreased with Trichlorethylen for LOX operation.		
	Date: 22.04.05	Signature: JMG	

LIN-Test

γ 0.7747 [daN/l]

Q [l/min]	p_{suct} [barg]	p_{del} [barg]	Δp [bar]	ΔH [m]	P_{el} 1) [kW]	$P_{mech.}$ [kW]	η_{pump} [%]	T [°C]	n [rpm]	$f_{Converter\ at\ operation}$ [Hz]
150	1.21	6.00	4.79	61.8	4.0			-191.9	3209	54
200	1.21	6.00	4.79	61.8	4.4			-191.9	3209	54
250	1.21	6.00	4.79	61.8	4.9			-191.9	3209	54
300	1.20	5.95	4.75	61.3	5.2			-191.9	3209	54
350	1.20	5.80	4.60	59.4	5.6			-191.9	3209	54
400	1.20	5.70	4.50	58.1	6.1			-191.9	3209	54
425	1.20	5.60	4.40	56.8	6.2			-191.9	3209	54

1) P_{el} measured at converter inlet

Labyrinth Seal

(measured at 400 l/min, 3209 rpm)

Sealgas:	Gaseous nitrogen at approx.15°C
Measure "A":	1.4 mm
Feed pressure:	5 barg
Reference pressure:	1.3 barg
Sealgas pressure:	1.3 barg
Sealgas flowrate:	25 mm = 2,9 Nm3/h

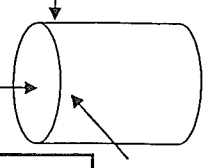
Remarks: Seal leakage, motor DE bearing RTD's, motor winding PTC thermistors and bearing heater: functional check OK

Impeller diam at test:	190 mm
Tip width:	6,5 mm
With Inducer	yes
With blade-ring	yes
Diffusor type:	600
Orifice Ø :	
Δp regulator No:	390/O_2

Vibrations: (at DE motorshield) 0.6 [mm/s]

(at 400 l/min)

0.4 [mm/s] →



0.4 [mm/s]

Sound pressure level (at 400 l/min)

76,5 dB(A)

	Date : 24.05.05	Signature: B. Gutknecht

sefco — Delivery Certificate

Ref. Nr.: 05.040/1B

Customer:	Air Liquide AGS GmbH - 4500023387 - ASU Košice - K70101		P40100
Pump Type:	CL-19 / EM-11		
Motor:	Manufacture : Halter	Type: DDG160MA2	Nr.: 05038543
	P: 11 [KW]	U: Y 400 [V]	I: 19,9 [A]
	n_{range}: 2750-3400	/ f_{range}: 47-58 [Hz]	$f_{field\ weakening\ point}$: 50 [Hz]
Pressure Test (EN 13275:2000/§5.2.2)	Hydraulic pressure test of pump casing completed at 60 bar for 5 min.		
	Date: 18.01.05	Signature: CP	
Degreasing (EN 12300:1999)	Pump cold end has been degreased with Trichlorethylen for LOX operation.		
	Date: 22.04.05	Signature: JMG	

LIN-Test

γ 0.7751 [daN/l]

Q [l/min]	p_{suct} [barg]	p_{del} [barg]	Δp [bar]	ΔH [m]	P_{el} 1) [kW]	$P_{mech.}$ [kW]	η_{pump} [%]	T [°C]	n [rpm]	$f_{Converter\ at\ operation}$ [Hz]
150	1.20	5.60	4.40	56.8	3.6			-192	3091	52
200	1.19	5.60	4.41	56.9	4.1			-192	3091	52
250	1.19	5.60	4.41	56.9	4.5			-192	3091	52
300	1.16	5.55	4.39	56.6	4.8			-192	3091	52
350	1.13	5.45	4.32	55.7	5.2			-192	3091	52
400	1.12	5.25	4.13	53.3	5.5			-192	3091	52

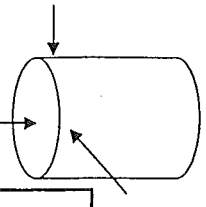
1) P_{el} measured at converter inlet

Labyrinth Seal	(measured at	400	l/min,	3091	rpm)
	Sealgas:	Gaseous nitrogen at approx.15°C			
	Measure "A":	1.4 mm			
	Feed pressure:	5 barg			
	Reference pressure:	1.25 barg			
	Sealgas pressure:	1.25 barg			
	Sealgas flowrate:	20 mm	=	2,5	Nm3/h

Remarks: Seal leakage, motor DE bearing RTD's, motor winding PTC thermistors and bearing heater: functional check OK

Impeller diam at test:	190 mm
Tip width:	6,5 mm
With Inducer	yes
With blade-ring	yes
Diffusor type:	600
Orifice ∅ :	
Δp regulator No:	390/O_2

Vibrations: (at DE motorshield) [mm/s]



Sound pressure level [mm/s]

dB(A)

	Date : 24.05.05	Signature:	B. Gutknecht

sefco	Delivery Certificate	Ref. Nr.: 05.040/1C

Customer:	Air Liquide AGS GmbH - 4500023387 - ASU Košice - K70101		P40100
Pump Type:	CL-19 / EM-11		
Motor:	Manufacture : Halter	Type: DDG160MA2	Nr.: 05038543
	P: 11 [KW]	U: Y 400 [V]	I: 19,9 [A]
	n_{range}: 2750-3400	/ f_{range}: 47-58 [Hz]	$f_{field\ weakening\ point}$: 50 [Hz]
Pressure Test (EN 13275:2000/§5.2.2)	Hydraulic pressure test of pump casing completed at 60 bar for 5 min.		
	Date: 18.01.05	Signature: CP	
Degreasing (EN 12300:1999)	Pump cold end has been degreased with Trichlorethylen for LOX operation.		
	Date: 22.04.05	Signature: JMG	

LIN-Test

γ 0.7751 [daN/l]

Q [l/min]	p_{suct} [barg]	p_{del} [barg]	Δp [bar]	ΔH [m]	P_{el} 1) [kW]	$P_{mech.}$ [kW]	η_{pump} [%]	T [°C]	n [rpm]	$f_{Converter\ at\ operation}$ [Hz]
150	1.19	5.25	4.06	52.4	3.4			-192	2970	50
200	1.19	5.25	4.06	52.4	3.7			-192	2970	50
250	1.16	5.20	4.04	52.1	4.1			-192	2970	50
300	1.14	5.15	4.01	51.7	4.4			-192	2970	50
350	1.12	5.05	3.93	50.7	4.8			-192	2970	50
380	1.11	4.95	3.84	49.5	5.0			-192	2970	50
393	1.12	4.90	3.78	48.8	5.0			-192	2970	50

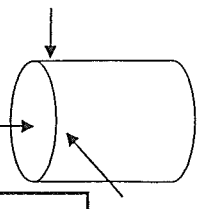
1) P_{el} measured at converter inlet

Labyrinth Seal	(measured at 380 l/min, 2970 rpm)	
	Sealgas:	Gaseous nitrogen at approx.15°C
	Measure "A":	1.4 mm
	Feed pressure:	5 barg
	Reference pressure:	1.22 barg
	Sealgas pressure:	1.23 barg
	Sealgas flowrate:	20 mm = 2,5 Nm3/h

Remarks: Seal leakage, motor DE bearing RTD's, motor winding PTC thermistors and bearing heater: functional check OK

Impeller diam at test:	190 mm
Tip width:	6,5 mm
With Inducer	yes
With blade-ring	yes
Diffusor type:	600
Orifice ∅ :	
Δp regulator No:	$390/O_2$

Vibrations: (at DE motorshield) [mm/s]



Sound pressure level [mm/s]

dB(A)

	Date : 24.05.05	Signature:	B. Gutknecht

Angst+Pfister

Suction hose item 3 on drawing
nº 05.040114

Angst+Pfister AG
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CH-8052 Zürich
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Angst+Pfister SA
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Case postale 19
CH-1219 Genève-Le Lignon
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Delivery address:
Angst+Pfister AG – Logistikcenter

CH-8424 Embrach
Telefon +41 1 866 66 11
Telefax +41 1 866 66 22

Bankverbindung:
CS, 8050 Zürich, Kto. 570500-91, BC 4857
UBS, 8050 Zürich, Kto. 803.917.01J, BC 269

Customer No. 111219

Sefco AG
Herr F. Brodesser
Wuhrmattstr. 15

CH-4103 Bottmingen

Sefco AG
Maschinen-Anlagen
Wuhrmattstr. 15

CH-4103 Bottmingen

Official in Charge: Frau Ch. Schweri
Tel. direct: 044 306 64 05
23.05.05 11:47:16 /

Inspection certificate EN 10204-3.1 B FT-A05.292282

Your reference			Our reference
Herr Brodesser / Best.Nr. 05/2629			Frau Ch.Schweri
Job No.	**Order Date**	**Delivery Date**	**VS**
FT-A05.292282	11.03.2005	20.05.2005	A+P Zürich

Order specification/acceptance requierements:

Test item:	Our part-no 80.0003.6158 Metal hose assembly ASSIWELL® 100 1.4541 DN 65, U1, NL 400 mm-PED Fitting 1: welding flange DN 65 PN 6 Fitting 2: welding flange DN 65 PN 6 Your part/drawing-no. 4 14868
Quantity:	1 pieces
Marking:	SB/A+P C540235-02, PS 6, DN 65, -196/+20°C, 05/2005, CE, 414868
Test:	Pressure and Tightness Test: 9 bar air Duration: 2 min.
Test result:	The hose(s) meet(s) the requirements.
Remarks:	

Material certificate

Element	Material	Ladle No.
Corrugated hose	1.4541	483669
Braid	1.4301	V3933
Welding Flange DN 65 PN 6	1.4435	E31602
Female fitting with gas parallel thread 3/8"	1.4404	453844

We hereby certify, that the material described above has been tested and complies with the terms of the order contract.

Best regards
Angst + Pfister AG

ppa. H. Birmele

i.A. Ch. Schweri

Konformitätserklärung

nach Druckgeräterichtlinie 97/23/EG

für ein Druckgerät

Der Hersteller

Senior Berghöfer GmbH

Frankfurter Str. 199
D-34121 Kassel

erklärt hiermit, dass das Druckgerät

Beschreibung / Verwendungszweck:	Rohrleitung/Wellschlauchleitung	
Typ-, Serien-, Fabrikationsnummer:	MW22U1 / C-540235-02 // 414868	
max. zulässiger Druck PS:	6,00	bar
zulässige max./min. Temperatur TS:	-196/+20	°C
Nennweite DN:	65	
Herstelljahr.	05/2005	
Aufgebrachter Prüfdruck PT:	9	bar
Prüfmedium:	Luft	

mit der Druckgeräterichtlinie 97/23/EG übereinstimmt.

Angewandte Konformitätsbewertungsverfahren:	Modul A
Angewandte Normen und techn. Spezifikationen:	AD 2000, DIN EN 287-1, DIN EN 288
Weitere angewandte EG-Richtlinien:	keine

Eingeschaltete benannte Stellen:

Überwachung QS-System:	--
Prüfung / Überwachung / Kontrollen während der Fertigung:	TÜV Hessen (0091)

Zugehörige Bescheinigungen:

EG-Entwurfsprüfbescheinigung Nr.:	./.
EG-Baumusterprüfbescheinigung Nr.:	./.
EG-Konformitätsbescheinigung Nr.:	./.

Ort, Datum:
Kassel, 12.05.2005

Unterschrift Lückhardt

Angst+Pfister

Discharge hose item 8 on drawing
n° 05.040/14

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Delivery address:
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Telefax +41 1 866 66 22

Bankverbindung:
CS, 8050 Zürich, Kto. 570500-91, BC 4857
UBS, 8050 Zürich, Kto. 803.917.01J, BC 269

Customer No. 111219

Sefco AG
Herr F. Brodesser
Wuhrmattstr. 15

CH-4103 Bottmingen

Sefco AG
Maschinen-Anlagen
Wuhrmattstr. 15

CH-4103 Bottmingen

Official in Charge: Frau Ch. Schweri
Tel. direct: 044 306 64 05
23.05.05 11:47:38 /

Inspection certificate EN 10204-3.1 B FT-A05.292282

Your reference			Our reference
Herr Brodesser / Best.Nr. 05/2629			Frau Ch.Schweri
Job No.	Order Date	Delivery Date	VS
FT-A05.292282	11.03.2005	20.05.2005	A+P Zürich

Order specification/acceptance requierements:	
Test item:	Our part-no 80.0001.5675 Metal hose assembly ASSIWELL® 100 1.4541 DN 40, U1, NL 450 mm-PED Fitting 1: 90° elbow welding flange DN 40 PN 40 Fitting 2: welding flange DN 40 PN 40 Your part/drawing-no. 4 14786
Quantity:	1 pieces
Marking:	SB/A+P C540235-01, PS 25, DN 40, -196/+20°C, 05/2005, CE, 414786
Test:	Pressure and Tightness Test: 38 bar air Duration: 1 min.
Test result:	The hose(s) meet(s) the requirements.
Remarks:	

Material certificate

Element	Material	Ladle No.
Corrugated hose	1.4541	G32040
Braid	1.4301	V3871
Welding Flange DN 40 PN 40	1.4435	502744
90° elbow	1.4435	843408

We hereby certify, that the material described above has been tested and complies with the terms of the order contract.

Best regards
Angst + Pfister AG

ppa. H. Birmele

i.A. Ch. Schweri

Konformitätserklärung

nach Druckgeräterichtlinie 97/23/EG

für ein Druckgerät

Der Hersteller

Senior Berghöfer GmbH

Frankfurter Str. 199
D-34121 Kassel

erklärt hiermit, dass das Druckgerät

Beschreibung / Verwendungszweck:	Rohrleitung/ Edelstahl-Wellschlauch	
Typ-, Serien-, Fabrikationsnummer:	MW22 U1 // C 540235-01 // 414786	
max. zulässiger Druck PS:	25,00	bar
zulässige max./min. Temperatur TS:	+20/-196	°C
Nennweite DN:	40	
Herstelljahr.	05/2005	
Aufgebrachter Prüfdruck PT:	38	bar
Prüfmedium:	Wasser	

mit der Druckgeräterichtlinie 97/23/EG übereinstimmt.

Angewandte Konformitätsbewertungsverfahren:	Modul A
Angewandte Normen und techn. Spezifikationen:	AD 2000, DIN EN 287-1, DIN EN 288
Weitere angewandte EG-Richtlinien:	keine

Eingeschaltete benannte Stellen:

Überwachung QS-System:	--
Prüfung / Überwachung / Kontrollen während der Fertigung:	TÜV Hessen (0091)

Zugehörige Bescheinigungen:

EG-Entwurfsprüfbescheinigung Nr.:	./.
EG-Baumusterprüfbescheinigung Nr.:	./.
EG-Konformitätsbescheinigung Nr.:	./.

Ort, Datum:
Kassel, 19.05.2005

Unterschrift Geselle

CERTIFICATE of CONFORMITY

Theo Halter GmbH
Elektromotoren
Gleisstrasse 36

68766 Hockenheim

The electrical apparatus:

Three phase asynchronous squirrel cage motors series:

DDG / DDA

are in conformity with the instructions of:

- 73 / 23 EWG
Low Voltage Directive amended by: RL 93 / 68 / EWG

- 89 / 336 / EWG
Directive on Electromagnetic Compatability
amended by: RL 91 / 263 / EWG, 92 / 31 / EWG and 93 / 68 / EWG

The conformity with the instructions of these directives is proved by the observation of the following standards:

1. IEC Publ. 34-1	Rating and performance NEN 3173; 1991
2. IEC Publ. 34-5	Degrees of protection (IP code) NEN-EN 60034-5
3. IEC Publ. 34-7	Classification of types of construction and mounting arrangements (IM code) NEN-EN 60034-7
4. IEC Publ. 34-9	Noise limits NEN-EN 60034-9
5. IEC Publ. 34-14	Limits of mechanical vibrations NEN 10034-14
6. IEC Publ. 34-8	Terminal markings and direction of rotation NEN 2248
7. IEC Publ. 72-1	Relationships of the dimensions and output rating of totally enclosed fan cooled 3-phase cage indution motors.

Hockenheim, 28.11.02
Theo Halter GmbH, Elektromotoren

T. Noor-Herbert ppa. F. Heinemann

This certificate attests to the conformity with the named directives, however, it is not a guarantee of properties in the meaning of product liability.