varisco®
solid pumping solutions

Operating Manual

V-Series
Internal Gear Pumps with Magnetic Coupling

SAX MAG®

Declaration of Conformity

in accordance with Directive 94/9/EC (ATEX) on equipment and protective systems intended for use in potentially explosive atmospheres

Certificate

Manufacturer: varisco solid pumping solutions

declares that

when ordered as ATEX pump or ATEX pump unit, the following pumps are in conformity with Directive 94/9/EC of 23 March 1994:

within the meaning of Machinery Directive 98/37/EC, Annex II A
and ATEX Equipment Directive 94/9/EC, Annex X B.

We hereby declare that the pump unit of the **V Series** described on page 1 under "Technical Data" delivered by us is in conformity with the following directives and standards:
EC Machinery Directive 98/37/EC, Annex I No. 1
ATEX Equipment Directive 94/9/EC, Annex II.

Applied harmonized European standards, in particular:

EN1127-1:1997	Explosive atmospheres – Explosion Protection, Part 1: Basic concepts and methodology
EN13463-1:2001	Non-electrical equipment for potentially explosive atmospheres – Part 1: Basic method and requirements
prEN13463-5:2002	Non-electrical equipment for potentially explosive atmospheres – Part 5: Protection by constructional safety (“C“)
prEN13463-6:2002	Non-electrical equipment for potentially explosive atmospheres – Part 6: Protection by control of ignition source (“b“)
prEN13463-8	Non-electrical equipment for potentially explosive atmospheres – Part 8: Protection by liquid immersion (”k“)

Applied national technical standards and specifications, in particular:

DIN EN ISO 9906	VDMA 24276
DIN 24250	VDMA 24279
DIN 31001	
DIN EN 22858	
DIN ISO 5199	
DIN EN 12723	

Marking:  symbol and certificate number are part of the marking.
Special requirements for safe operation are described in the supplementary operating instructions for pumps in potentially explosive atmospheres.

Table of Contents:

1 General

This state-of-the-art Varisco pump has been manufactured with greatest care and is subject to continuous quality control.

The present Operating Manual will familiarize you with the pump, its intended purpose and fields of application.

This Operating Manual contains important information on the safe, proper and efficient operation of the pump. Follow these instructions to ensure the pump's reliable operation and long service life and to avoid potential risks.

This Operating Manual does not include any site-specific regulations. The owner of the pump is responsible for complying with such regulations. This also applies to the assembly/installation personnel concerned.

This pump unit must not be operated beyond the operating limits specified in the technical documentation in terms of pumped medium, delivery rate, speed, density, pressure, temperature and motor power or other instructions given in the Operating Manual or contract documentation. If you have any questions or require further information, please do not hesitate to consult the manufacturer.

Pump series/size, major operating data and the series number are indicated on the rating plate. We kindly request you to supply this information whenever you have questions, for supplementary orders and when ordering spare parts.

2 Safety

This Operating Manual contains important information to be observed during installation, operation, supervision and maintenance. Therefore, ensure that the fitter of the pump and the future operator/owner carefully reads and understands this manual **prior to installation and commissioning.** Make sure that this Operating Manual is always available at the place where the pump is used.

Apart from the general safety instructions provided in this Section**,** all other relevant safety information, particularly as regards the use of the pump in potentially explosive atmospheres as described in Section 2.9 must also be observed.

- ***Persons who have a pacemaker must not stay in the vicinity of the pump because of the pump's strong magnetic field!***
- ***Be aware of potential hazards (both during transport and handling) before returning the unit.***

2.1 Marking of instructions/notes in the Operating Manual

Safety information contained in this Operating Manual is indicated by the following symbol:

General hazard symbol for areas according to ISO 7000 – 0434

Non-compliance with the safety information provided may cause hazards to persons.

Warning of electric power:

Safety symbol according to IEC 417 - 5036

and explosion protection:

Safety instructions pertaining to machines and their functions are indicated by the following symbol:

Non-compliance with these notes may cause hazardous conditions for the machine and its functions.

The following warning sign is used to indicate that persons who have a cardiac pacemaker are at risk, for example, due to the strong magnetic field:

Warning of a magnetic field:

It is imperative to observe important information/signs directly attached to the machine such as

- Sense of rotation arrow
- Symbol for liquid connections
- Rating plate

Make sure they are kept clean and are easily legible.

2.2 Qualification and training of personnel

The personnel entrusted with the operation, maintenance, inspection and installation of the pump must be suitably qualified for the job.
The owner must clearly define scopes of responsibility, competences and supervision of the personnel. If operators are not sufficiently qualified, they are to be trained and instructed appropriately. On request by the owner of the machine, the manufacturer/supplier may provide such training, if necessary. Furthermore, the owner must ensure that the personnel has read and fully understands the contents of this Operating Manual.

2.3 Risks involved in non-compliance with safety instructions

Non-compliance with safety information may result in risks/hazards to persons, the environment and the machine. Furthermore, non-observance of safety instructions may result in the loss of any and all claims for damages.

In particular, non-compliance of safety information may result in the following hazards/risks:

- Failure of important machine/equipment functions
- Failure of specific methods for maintenance and repair
- Risks to persons caused by electric, mechanical and chemical effects as well as explosions,
- Environmental hazards caused by leaks of hazardous substances.

2.4 Safety-conscious work

All safety information included in this Operating Manual, as well as all applicable national and international regulations on explosion protection, accident prevention and in-house labour, industrial and safety regulations of the owner shall be observed.

When the pump unit is used in areas with potentially explosive atmospheres, it is imperative to observe the sections in this Operating Manual marked with the **Ex** symbol.

2.5 Safety instructions for the owner/operator

If hot or cold machine parts may cause potential risks, such parts must be protected against contact.

Contact protection on moving parts (e.g. coupling) must not be removed when the system is running.

Persons who have a pacemaker must not stay in the vicinity or bring parts of the magnetic coupling close to their body because of the effects of the strong magnetic field.

If hazardous media (e.g. explosive, toxic, hot) leak out, they must be drained off to prevent exposure of people or the environment to any risk. Relevant legal provisions must be observed. Furthermore, the magnetic field might damage data carriers and electronic components.

Take measures to prevent any danger caused by electricity. (For details, please consult country-specific regulations and/or information issued by local energy supply companies/ public utilities).

If the units are used in locations subject to explosion hazards, make sure the unit is operated as intended.
Non-compliance may cause the pump to exceed the operating temperatures specified.

2.6 Safety instructions for maintenance, inspection and installation work

The owner has to ensure that all maintenance, inspection and installation work will be performed only by authorized and duly qualified personnel who is well familiar with the contents of this Operating Manual.
The pump must have ambient temperature. It must be depressurized and drained of any product.
Work on the machine should typically be carried out only when the machine stands still. It is imperative to follow the shutdown procedure described in this Operating Manual.
Pumps or pump units that discharge media hazardous to health must be decontaminated. All safety and protective covers should be reattached or their function restored immediately upon completion of work.

Prior to restarting the pump, follow the notes listed in the Section “Start-up and placing out of service“ (6.).

2.7 Conversion and production of spare parts by customer

Any modification of or changes to the machine are only allowed after previous consultation of the manufacturer or within a scope permitted by the manufacturer. Original spare parts and accessories authorized by the manufacturer should be used because they guarantee safety. The use of other parts may annul liability for any resulting consequences.

2.8 Improper modes of operation

Operational safety is only guaranteed if the equipment is used properly in compliance with the following sections of the Operating Manual. Make sure the operating limits specified in the data sheet are not exceeded under any circumstances.

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2.9 Explosion protection

If the units are used in potentially explosive areas, always follow the notes on measures to be taken and instructions provided in Sections 2.9.1 to 2.9.6 to guarantee explosion protection.

2.9.1 Filling the unit

Normally the system of suction and discharge lines and consequently the pump's interior that is in contact with the fluid is permanently filled with the pumped medium during pump operation to prevent any potentially explosive atmosphere and the risk of dry running.

If the operator cannot meet this requirement, we recommend providing appropriate monitoring facilities. Moreover, ensure that auxiliary, heating and cooling systems are filled properly.

2.9.2 Special operating conditions

In the standard model of the pump, the inner (fluid-filled) space of the magnetic coupling is cooled by a partial flow that branches off from the main fluid flow. If particular properties of the fluid (sticking, clogging) lead to a disruption of the cooling flow, the temperature may rise inadmissibly. If such risk exists, make sure to take suitable monitoring measures (see 4.3.4).

In case of overloading, overheating or non-observance of design data or improper selection of the magnetic coupling, the internal and external magnet may become desynchronized. Furthermore, thermal energy generated in the containment shell or on the external magnet may also cause an inadmissible rise in temperature. If such risk exists, make sure to take suitable monitoring measures (see 4.3.4).

If an environmental hazard arises as a result of damage to the containment shell (rare incident) causing liquid to leak, make sure to provide leakage detection facilities (see 4.3.4). If necessary, check if there is any potential interaction between the liquid and the pumped medium.

2.9.3 Markings

Markings and signs on the pump refer only to a specific pump section, i.e., shaft coupling and motor should be considered separately. A Manufacturer's Declaration with the appropriate marking is required for the shaft coupling. The drive is subject to a separate marking on the pump section. Example of marking on the pump section: **II 2 GT3 -T4.**

The marking shows the range of theoretically available temperature classes. Admissible temperatures depending on the relevant pump design are specified in 2.9.6.

Variant 1:

II 2 G Eex c T3 – T4

II 2 G: Surface unit intended for use in an area where an explosive atmosphere in the form of gases or mists is likely to occur occasionally in normal operation (EN 1127-1 Sec. 6.3)

Eex c: Equipment with protection by constructional safety (prEN 13463-5)

T3 – T4: Temperature classes T3 – T4

Variant 2:

II 2 G Eex c Tx

II 2 G:  e unit intended for use in an area where an explosive atmosphere in the form of or mists is likely to occur in normal operation occasionally (EN 1127-1 Sec. 6.3)

Eex c: Equipment with protection by constructional safety (prEN 13463-5)

TX: If the pump is used in a potentially explosive area, the attached temperature monitor will switch off the pump automatically 10°C before the maximum admissible temperature for the site of application is reached. On the suction side of the pump the temperature of the pumped medium should be at least 10°C below the temperature specified for shutdown.

2.9.4 Checking the sense of rotation

If there is a risk of explosion during the installation phase, do not check the sense of rotation under any circumstances by briefly switching on the unfilled pump in order to prevent any possible rise in temperature in case of contact with rotating or stationary parts.

2.9.5 Mode of operation of the pump

Open all gate valves and shut-off elements in the piping. The pump must not discharge against a closed system!

2.9.6 Temperature limits

Under normal operating conditions, expect the highest temperatures to occur at the surface of the pump casing, the magnetic coupling and antifriction bearings. The surface temperature occurring on the pump casing is equivalent to the temperature of the pumped medium. If the pump is heated, ensure that the temperature classes specified in the Annex are observed. In the area of the bearing frame the pump must have free contact with the environment.

At any rate, the owner of the plant must ensure that the specified fluid temperature (operating temperature) is observed. The maximum admissible temperature of the pumped medium depends on the relevant temperature class.

Temperature classes according to EN13463-1 are given in the table below together with the resulting theoretical limit values for the pumped medium.
The maximum admissible temperature of the pumped medium depends on the temperature class and the operating conditions of the pump. The temperatures given in the table below refer to a maximum ambient temperature of 40°C.

Temperature classes Tmax. acc. to EN 13463-1	Temperature Pumped medium
T4 – 135°C	125°C
T3 – 200°C	190°C
T2 – 300°C	290°C
T1 – 450°C	290°C

Safety information:

The relevant admissible operating temperature of the pump is indicated in the data sheet. If the pump is operated at a higher temperature and no data sheet is available or the pump is used as a “pool pump”, contact the manufacturer for the maximum admissible operating temperature of the pump.

Assuming an ambient temperature of 40°C, grease lubrication and proper maintenance and operation, ensure that temperature class T4 is maintained for the antifriction bearings. Dry-running may not only occur in the event of an insufficiently filled interior, but also in the presence of high gas contents in the pumped medium. Operating the pump outside the admissible range may also lead to dry-running (e.g., due to evaporation in the interior).

2.9.7 Maintenance

For safe and reliable operation, make sure the unit is properly serviced and kept in perfect technical condition. This also applies to the function of the antifriction bearings.

The actual service life of the antifriction bearings depends on the mode of operation and the specific conditions on site. Regular checks of the running noise prevent the risk of excessive temperatures caused by overheated bearings, start-up of the external rotor on the lantern or defective bearing seals. Regularly monitor vibration behaviour to ensure the proper functioning of the plain bearings. If auxiliary systems are installed, check to see whether monitoring facilities should be installed to ensure proper functioning.

2.9.8 Safety and accident prevention standards

Wear appropriate clothing when working in the vicinity of the pump. Avoid loose garments with loose parts (ties, scarves, etc.) that could get caught in moving components. Wear protective clothing that meets safety regulations: gloves, insulating footwear, goggles, hearing protectors and helmet (see figure on the right).

Do not perform any maintenance work with the motor running. Do not come close with your hands to any moving parts (e.g. belts, couplings, etc.) Do not come close with your hands to hot motor parts. Do not step on the motor pump to perform interventions.

CAUTION!

Switch the motor off in case of emergency. Inform the personnel responsible for the plant.

3 Transport, intermediate storage

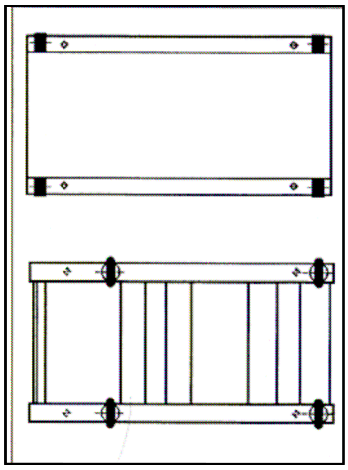
3.1 Transport

The pump unit must be transported properly by competent personnel. Make sure that the pump or pump unit remains in a horizontal position during transport so that it will not slip out of the transport suspension points.

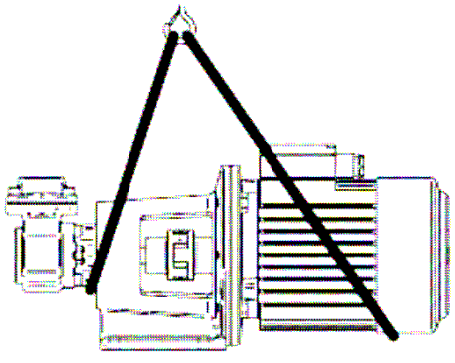
It is not permitted to attach the slinging ropes to the free shaft end of the pump or to the ring loops of the motor. Any slippage of the transport suspension points may cause risk of personal injury and damage to property. Please note that the ring bolt on the bearing lantern is the only slinging point for the pump.

Make sure to use suitable lifting devices for transport. The transport locking devices supplied with the pump can be removed after transport.

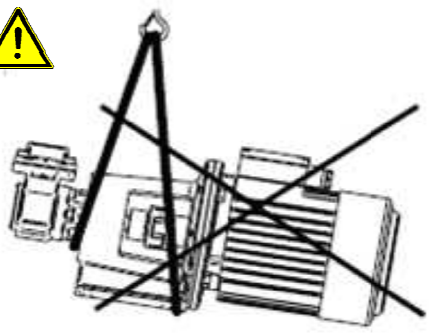
During start-up and maintenance, ensure safe transport of all components. To this end, suitable suspension facilities should be used.
Transport and handling must be performed by competent personnel in order to prevent any damage to the pump and injuries to personnel.
The lifting lugs of the various components may only be used for lifting components. The suspension points of some support frames are indicated in **bold** in the figure on the right.



Max. lifting speed: V/max < 0.5 m/s



Always use two ropes to be secured in such a way that the pump cannot slip. Make sure that the pump unit is suspended in a horizontal position!
!



Never lift the pump at one suspension point only. Incorrect lifting may result in personal injury and/or damage to property.

3.2 Intermediate storage/preservation

As required, pumps should be tested and set using a liquid that also serves to protect the pump's interior for a period of six months from the time of delivery. This liquid is a mixture of lube oil and passivating neutral detergent.
Clean the pump prior to installation if the filled-in liquid might contaminate the product to be pumped.

Never start up the pump with water and do not leave any traces of water in the pump.

3.3 Return

Pumps that have delivered corrosive or poisonous media must be thoroughly flushed and cleaned before they are returned to the manufacturer.

A declaration of conformity confirming that it is safe to use and a safety data sheet for the medium must be enclosed with the returned pump (see Annex "Certificate of Conformity"). Please state safety precautions and decontamination measures taken.

4 Description of the product and accessories

4.1 General description

4.1.1 General description of the pump

V-Series internal gear pumps are volumetric rotary displacement pumps with internal gears designed to deliver fluids of any viscosity. The flow of the fluid to be delivered is produced by two gears: The directly driven rotor designed as a gear and the pinion which, also designed as a gear, engages the rotor in an off-centre configuration.

Rotor and pinion are isolated from one another by a stationary steady (crescent-shaped partition). For the pumped fluid to be drawn in (inlet), the teeth of the rotor and the pinion in engagement will come out of mesh, whereas the teeth moving into mesh will result in discharge of the fluid (outlet).

The pump shaft is supported in the bearing housing in a plain bearing; similarly, the pin of the pinion (single-ended shaft) is also supported in a plain bearing. The plain bearings are lubricated by the pumped fluid. The pumps are self-priming. Optionally, the pumps are equipped with a safety relief valve (a pressure relief valve designed as a bypass). When the valve operates, as a rule fluid will flow from the discharge side to the suction side of the pump, which - in an extreme case - can entail recirculation (internal circulation) with overheating.

It is the key property of pumps with magnetic couplings (VTRM Series) that they are driven through a magnetic coupling. The external magnet core is connected to the motor shaft; it serves to transmit the torque to the internal magnet core that is mounted to the pump shaft. The magnetic field generated by the motor-driven magnet hub with the externally placed set of (permanent) magnets causes the internal magnet core and, thus, the rotor to rotate.

Arranged between the two magnet cores is a containment shell which hermetically seals the pumped fluid from the atmosphere without any shaft seal fitted. Suitably designed coolant and lubricant grooves are provided to continuously dissipate heat to which the magnetic coupling is exposed because of eddy current losses. The coolant flow is returned to the pump's suction side through the gap between the containment shell and the internal rotor, via the internal rotor's rear side and a centre port in the pump shaft.

Pumps with a drive-end magnetic coupling and a pressure relief valve at the opposite end do not have any dynamic shaft seals fitted. These pumps are hermetically sealed.

The drive shaft which mounts the magnet hub at its drive end is supported in the bearing flange in two ball bearings with a shaft seal made of Perbunan fitted to cover the bearings towards the outside. Where it is desirable to monitor the temperature on the magnetic coupling the pumps can be equipped with a PT 100 temperature sensor that is inserted into the flange of the containment shell from above. Moreover, provision for PT 100 temperature monitoring is made directly on the pump casingr.

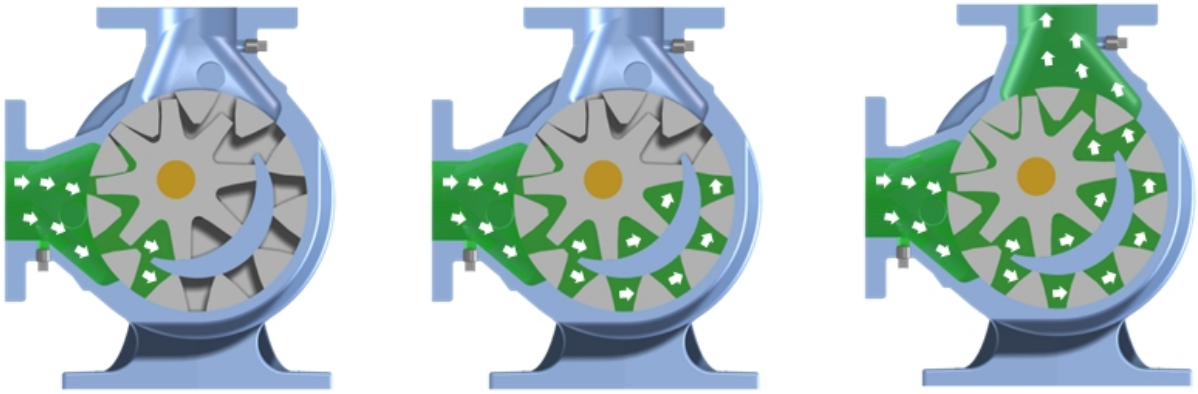
The maximum operating pressure for all pump types is in the range from 8 to 16 bar, depending on pump type, design and operating conditions.

The ambient temperature range T_A is: - 40℃… to T_A + 60℃.

The maximum allowable operating temperature range (at the same time the pumped-fluid temperature range) is: - 40℃ to + 220℃.

4.1.2 Operating principle

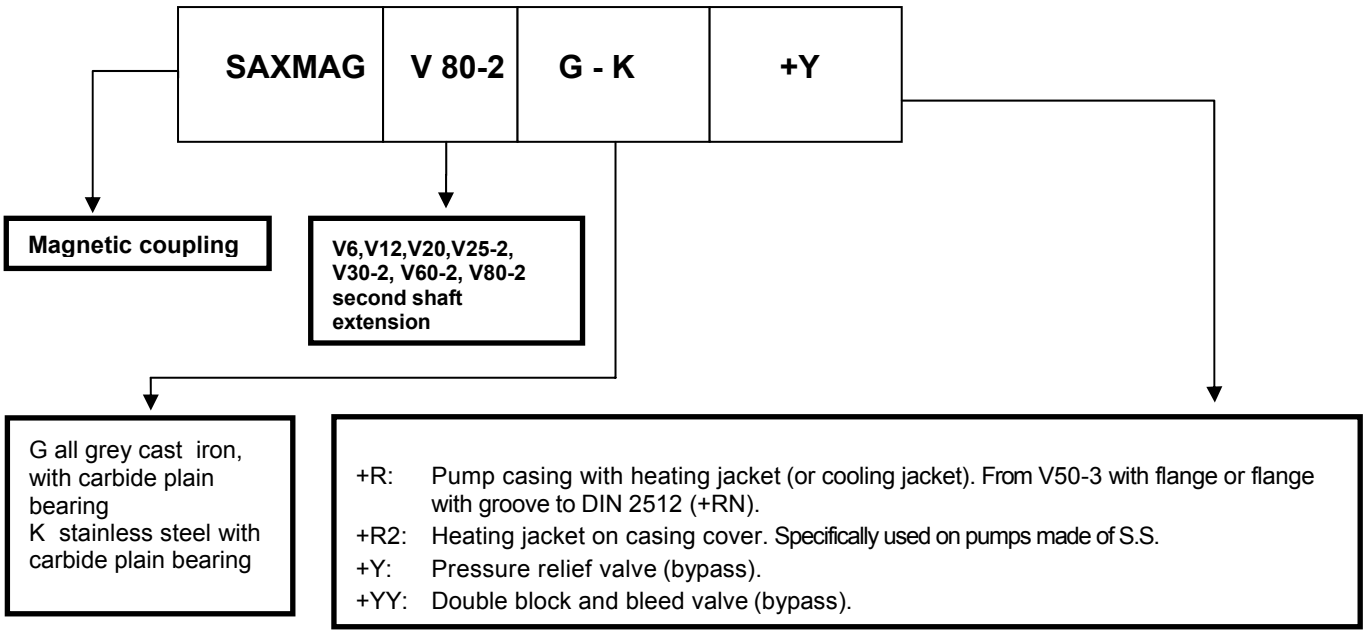
Arranged in a pump casing a gear pump has two gears that mesh to provide its pumping action through rotation in opposite senses. The gears are mounted on two shafts which, in turn, are supported in the pump casing and the pump cover. One of the two gears is driven through a shaft, with the former also driving the second gear in mesh. As the space between any two teeth opens a pressure below atmospheric is generated, drawing the fluid into the pump and advancing it between the tooth spaces and the casing wall. In the area where the teeth re-mesh the fluid is forced from the tooth gaps and into the outlet. Thus, the fluid can also be delivered against a higher pressure.



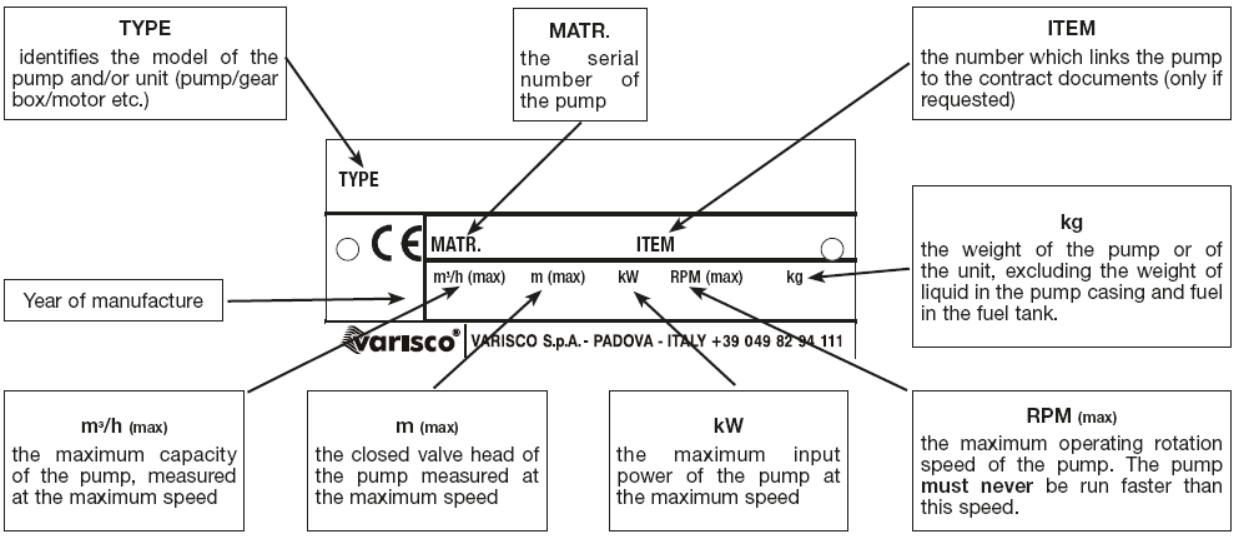
The figure above shows the liquid as it advances through the pump; the point where the teeth come out of mesh governs the phase of the liquid entering between the rotors and is, therefore, physically located close to the suction zone. The liquid is carried between the teeth and the steady and the discharge opening developing as the teeth come into mesh eject the liquid.
The permanent-magnet coupling guarantees operation that requires no maintenance, it is without leakage, and prevents air entrainment, e.g., when product is drawn in from a vacuum.

4.2 Designation

4.2.1 Marking of the pump

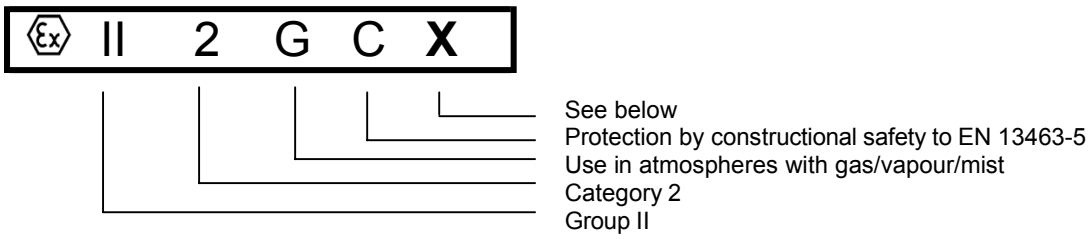


4.2.2 Nameplate



The data on the nameplate relates to a final acceptance with oil at 20℃ and a viscosity of 100 cSt.

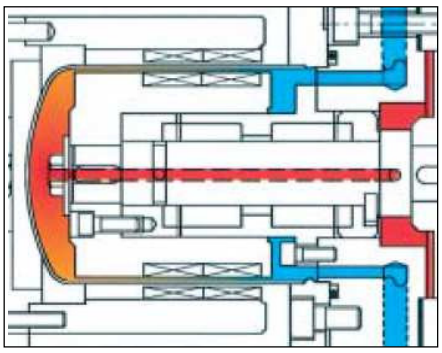
4.2.3



As the actual maximum surface temperature varies with the temperature of the pumped fluid rather than the ignition sources, no marking is made to show a temperature class or temperature. The marking includes the symbol "X" and reference to surface temperatures occurring is made in Section 2.9.6 of this Operating Manual.

4.3 Main components

4.3.1 Magnetic coupling



The external rotor is driven by an electric motor through antifriction bearings. It is due to the magnetic forces of the permanent magnets that the internal rotor is driven in synchronism with the motor speed. The rotating magnetic field induces in the containment shell eddy currents attributable to the conductivity of the latter. Hence, there is a heat build-up in the containment shell. In the hydraulic section, part of the pumped fluid is branched off through ports in the rear casing cover, to pass through the inside of the containment shell and return through a shaft bore, thereby dissipating heat. The hydrodynamic plain journal bearings are lubricated by the pumped fluid present in the containment shell.

4.3.1.1 Internal rotor

The internal rotor is mounted on the pump drive shaft. The magnets are pasted on the rotor outside and hermetically sealed in to protect them from chemical attack.

4.3.1.2 External rotor

The external rotor with the coupling hub is mounted on the motor shaft. The magnets sit on its inside. The magnets actually fitted are provided as a function of the torque to be transmitted by the coupling.

4.3.1.3 Magnets

The magnets consist of high-grade samarium cobalt (SmCo). Outstanding features are high magnetic energy density and low unit volume as well as a high field service temperature limit. Given the magnets' limited chemical resistance the internal rotor is encapsulated (i.e., hermetically sealed).

4.3.2 Bearings

The drive-end shaft is supported in deep groove ball bearings which, featuring C3 bearing clearance and high-temperature grease packing, have sealing washers on either side.
The pump-end shaft is supported in hydrodynamic carbide plain bearings which are lubricated by the pumped fluid.

4.3.3

Pump component	Materials	
Pump casing	S.S.	Grey iron
Shaft	Ceramics-coated S.S.	
Plain bearings	Carbide / Bronze	
External magnet	Samarium cobalt (Sm2Co17)	
Internal magnet	Samarium cobalt (Sm2Co17)	
Containment shell	1.4571 S.S.	
Radial shaft seal	Perbunan (temperature-resistant up to 100°C)	
Gaskets between containment shell and bearing housing	Centellen / PTFE	

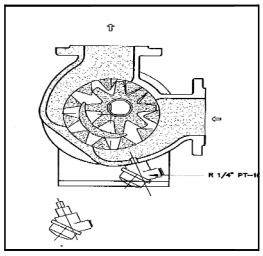
4.3.4 Monitoring

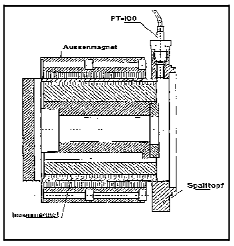
Depending on the unit's operational reliability and availability requirements, it is recommended that appropriate monitoring equipment be fitted.

On request we can supply equipment for the following functions:

Level monitoring to prevent running dry;
Temperature monitoring on the containment shell to detect overtemperature inside the containment shell (must be fitted as called for in the ATEX certification);
Pressure monitoring;
Motor monitoring (current consumption).

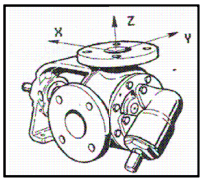
Temperature monitoring





4.3.5 Permissible forces, torques and moments on the pump branches

Pump Type	Flange (DN)	F_x, F_y, F_z N	M_x, M_y, M_z Nm
V6, V12	15	196	99
V20, V25-2, V30-2	40	520	260
V60-2	50	650	330
V80-2	80	1,040	520
V100-2	100	1,300	660



4.3.6 Expected noise

The sound pressure level of V-Series Varisco pumps with drive, as measured at the pump height at 1 m distance from the pump, is less than 75 dB for all models.

4.4 Accessories

Shaft coupling: Flexible coupling with / without adapter sleeve
Touch guard: Coupling guard
Baseplate: Welded fabrication, for complete (to ISO 3661) unit (pump and motor) of torsionally rigid design.
Where complete units are delivered the coupling and the coupling guard will be furnished by the supplier.

4.5 Dimensions and weights

Dimensions and weights can be seen from the pump's installation drawing.

5 Mounting/Installation

5.1 Safety regulations

Equipment operated in potentially explosive atmospheres must comply with relevant explosion protection regulations. This requirement is clear from the rating plates of the pump and the motor.
Persons who have a pacemaker should not be allowed in the vicinity of the strong magnetic field generated by the magnetic coupling. Persons within 2 m of the pump would be risking their lives!

5.2 Installation

5.2.1 Checks

- Prior to starting installation, inspect and check the entire unit and system.
- Check to make sure that the data of the unit (specified on the rating plate, in the documentation, etc.) is in conformity with the hazardous zone, the category and the system requirements.
- Damage as may have occurred: The pump unit to be installed must be in a sound condition and is required to have been stored properly (for three years max.) prior to installation. In case of doubt or if damage is found, please contact your supplier of Varisco pumps.
- Care must be taken to make sure that hot air from other installations or systems does not adversely affect the environs of the pump system; the ambient air temperature must not exceed 40℃.

5.2.2 ATEX Certification

All additional components such as couplings, guards, drive, motor, peripheral equipment, etc. must be covered by the ATEX 95 certification or certified separately for the appropriate temperature category. The assembled pump unit is required to have a separate certification and a separate rating plate which is supplied by the manufacturer of the pump unit.

5.3 Checks prior to installation

Mount the pump as close as possible to the tank of the liquid to be pumped and allow sufficient space around to facilitate maintenance work, inspection and checks. Keep enough free space specifically in front of the pump to permit the guard to be attached.

- The pump and the system must be accessible for maintenance and inspection during operation.

- Make sure that there is unobstructed air supply to the pump, the drive and the motor.
- An electric motor should have a clearance of not less than 25% of the motor diameter.
- The pump should be mounted horizontally and placed directly on the pump feet. Any mounting position other than specified will have an impact on draining, filling and venting of the pump as well as on the magnetic coupling's proper function.
- The bearing bracket needs to be free-standing in the atmosphere to permit cooling and guarantee proper functioning and lubrication of the grease-lubricated ball bearings. Inadequate cooling may entail unacceptable surface temperatures of the bearing bracket, insufficient lubrication and, thus, premature ball bearing failure. Where adequate cooling cannot be guaranteed at all times there will be a need for the bearing bracket's surface temperature to be monitored.
- Make provision for equipotential bonding between the pump and the foundation. In locations similar to areas in potentially explosive atmospheres, the connection to electric power must conform to IEC 60079-14.

5.4 Foundation

The structure must be prepared such that the dimensions conform to those shown in the dimensional drawing/installation drawing.
The concrete foundations shall have a sufficient concrete strength (at least Class X0) to permit safe and functional mounting according to DIN 1045 or an equivalent standard.
The concrete foundation must have completely cured prior to putting the unit in place. Its surface must be horizontal and level. The anchor bolts must be suspended in the baseplate.
Support the pump system or parts thereof on vibration dampers (where necessary) so as to reduce transmission of vibrations and noise to the environment.
Smaller pumps may be installed in the piping without any foundation. In such an application, install vibration dampers between the pump and the piping so as to prevent transmission of vibrations from the pump to the piping system.

5.5 Piping

Piping connected to the pump must not transmit forces, torques or moments to the latter; it may be necessary to support connected pipes upstream of the pump.
Piping must be adequately dimensioned. The size to be chosen should not be less than that of the pump nozzles. It is recommended for the suction side that the next larger nominal size be chosen compared with that of the pump's suction nozzle.

The following are guide values for the max. flow velocities in the piping:

Piping	Recommended flow velocity in the piping system [m/s]
Suction line	0.5 ... 1.0
Discharge line	3.0 ... 5.0
Recirculation line	1.0 ... 2.0

Circumferential speed:

Pump type	Drive-shaft diameter [mm]	Max. speed [rpm]	Maximum circumferential speed [m/s]
V 6	14	1,450	1.06
V 12	14	1,450	1.06
V 20	14	1,450	1.06
V 25-2	22	1,450 (1,000)	1.67 (1.09)
V 30-2	22	1,450 (1,000)	1.67 (1.09)
V 50-3	30	700	1.09
V 60-2	35	640	1.14
V 70	40	500	1.04
V 80-2	40	500	1.04
V 100-2	55	350	1.00

As set forth in prEN 13463-5:2002 Section 5.1, no friction-induced temperature rise is anticipated to occur on the shaft seals at circumferential speeds of 1 m/s.

To prevent entry of foreign matter, which may result in destruction of the pump, a suction filter with a filter rating needs to be installed on the inlet side. Given its inner flow resistance, the filter rating must be sufficiently large since it affects the pump's suction capacity.
Bends in the piping laid should have a radius as large as practical. Small-angle pipe elbows should be avoided.

Pump type	Filter rating [mm]
V6, 12, V20, V25-2, V30-2, V60-2, V80.-2 , V100-2	0.5

6 Start-up and placing out of service

At the pump start-up phase, particular care must be taken to meet the requirements listed below so as to avoid costly incidents - See in the manuals of the various pump versions which spare parts are recommended for start-up.

Prior to starting the pump, it is crucial that the following checks be conducted:

Check the alignment of the pump with the supporting structure as may be provided, and the motor. Check that the filter and the piping are free from remainders, small welded pieces, etc. Flanges are required to have undergone a leakage test.

Piping must not exert an excessive load on the pump casing. See the max. permissible loads in the technical section. Where the liquid can reach high temperatures it must be ensured that expansion joints are installed in the piping. Check the motor’s electrical connections, the balancing of the electric motor's power and the sense of rotation.

Check that the pump's direction of rotation is correct. The safety relief valve (if to be installed) must be correctly mounted. Move the pump shaft and check to be sure that it rotates freely. The pump interior, in particular on a self-priming pump, must not be dry. Fill or lubricate the internal components with the fluid to be pumped or a fluid that is compatible with the latter.

All pumps are protected during installation by a passivating oily liquid. If the latter is not compatible with the pumped fluid the pump must be removed and cleaned. Prepare the taps for connecting a pressure gauge and a vacuum gauge.

Check that the oil reservoir in the vicinity of the seal/gasket is filled.
Do not use the gear pump for tests or final acceptance tests with water.
Consult customer service if fluids need to be pumped which differ from those for which the pump has been sold.
Check that all valves are open.
Following pump starting, check that fluid has entered and the pump functions properly. Stop the pump and inspect both the pump and the system if the pump is still running dry after one minute.

7 Removing the pump

If the pump is under warranty you will need to contact Varisco ***prior to removing the pump***. Otherwise, warranty claims will be null and void.

Prior to opening the pump, make sure that:

it is completely depressurised;

all its content was drained and the pump flushed;

it was vented and allowed to cool down.

8 Risk analysis according to EN 13463-1

Predictable malfunction denotes equipment trouble which, usually occurring in the field, entails a situation such that the pumps do not function any longer as intended or fail to meet the design parameters.

When operating the pumps the following aspects need to be given particular consideration:

Faulty design: Failure of a pump component (e.g., bearing damage);

Trouble caused by external effects: Obstruction attributable to foreign matter in the pumped medium, or discharge-side clogging;

Overtemperature resulting from recirculation when the pressure relief valve has operated;

Operator's failure to conduct checks as necessary.

Referring to the appraisal of malfunctions, it can be anticipated that predictable malfunction because of faulty design or installation faults is ruled out by implementing the 'Internal Production Control' quality assurance system established at the manufacturer's in conformity with Annex VIII of the Directive 94/9/EC. This quality system, while guaranteeing design in line with good engineering practice, also serves to ensure that agreements with the customers as well as the design solutions chosen are in conformity with Directive 94/9/EC and the underlying standards.

Consistent compliance with the operating manual and maintenance instructions implies that loss of control of the pumps by the operators is ruled out.

An assessment of concrete design solutions with respect to ignition hazards (acc. to EN 13463-1) is made in the table below (see next page).

Potential ignition source		Measures	Reference to standards considered
Normal service	**Trouble to be expected**		
Hot surface	-	Make sure that the max. permitted temperature is not exceeded!	EN 13463-1
-	**Hot surface**	Make sure that the rotor, the pinion and the plain bearings are properly lubricated. Every precaution must be taken to prevent the pump running dry!	EN 13463-1 5.2.; 6.1.2.
Mechanical sparking		The materials employed are stainless steel or ductile cast iron. These materials are permitted as set out in EN 13463-1. All bearings are made of stainless steel.	
	Mechanical sparking	Mechanical sparking which could ignite a potentially explosive atmosphere is not considered as a trouble to be expected.	
	Faster-than-normal heating of the gland packing	Lubrication of the packing rings must be ensured. Temperature monitoring is essential – see Section 5.1	
	Faster-than-normal heating of shaft seals and mechanical seals	Quenching and flushing liquid must be checked. Pump must not be allowed to run dry!	Operating Manual
Electrostatic charges		During normal service, while complying with the design criteria, dangerous electrostatic charges which can result in discharge sparks that could ignite a potentially explosive atmosphere are ruled out as trouble to be expected since →the thickness of a paint coat that may not be electroconductive is less than 0.2 mm; →there are no exposed components of non-conductive plastics in pumps; →all conductive components of the pump are in metal-to-metal contact to one another and the pump is included in the equipotential bonding system of the equipment; →it needs to be remembered that a flexible coupling with non-conductive elastoms functions as insulation. ***Potential differentials*** between the individual assemblies (pump and motor) are prevented in that all the assemblies of the pump are bonded through metal-to-metal screwed joints and, in the end, the pump is included in the equipotential bonding system of the equipment (earthed). The oil film between the rotating and the stationary components is not considered a mutual insulation. However, it should be remembered that a flexible coupling with non-conductive elastomers between the motor and the drive shaft functions as insulation.	EN 1127-1 6.4.7 EN 13463-1 7.4.1, 7.4.2, 7.4.4, 11
Ignition sources other than those described above are not likely to occur. Therefore, no further evaluation of ignition hazards is required.			

Trouble	Potential causes	Trouble shooting
No fluid delivered	1. Pump not filled with fluid. 2. Discharge suction valve closed 3. Incorrect sense of rotation 4. Suction line clogged 5. Filter clogged 6. Leaky suction line 7. NPSH too low (excessive manometric suction head) 9. Relief valve opens too early or fails to close 10. Magnetic coupling slips	1. Fill the pump 2. Open the valve 3. Reverse sense of rotation, taking note of the arrow on the pump. 4. Eliminate clogging 5. Clean the filter 6. Find and eliminate leakage 7. Increase diameter of suction line and/or piping. Reduce manometric suction head. Consider vapour pressure of pumped fluid; alter arrangement, if appropriate. 9. Set opening pressure. Check valve mechanism 10. Stop motor immediately and eliminate cause of pump obstruction trouble.
Insufficient delivery rate	1. Back pressure higher than designed 2. Leaky suction line 3. Speed too low 4. Suction line clogged 5. Filter clogged 6. Viscosity higher than designed 7. Relief valve incorrectly set or leaking 8. Insufficient suction pressure 9. Worn pump components (gears, sliding plate)	1. Reduce pressure drop 2. Inspect suction line for leaks 3. Check speed (contact manufacturer). 4. Eliminate line clogging 5. Clean the filter 6. Reduce viscosity or re-design pump. (contact manufacturer) 7. Re-set relief valve or renew gasket 8. Increase suction pressure 9. Renew components
Pump's suction capacity diminishes	1. Piping improperly designed 2. Discharge line shut off 3. Suction line shut off 4. Pump worn 5. Suction line leaky	1. Check sizing of piping 2. Open shutoff valve 3. Open suction valve 5. Inspect suction line for leaks
Pump causes noise	1. Cavitation - excessive manometric suction head 2. Rotor/Teeth deformed 3. Pump/Motor misalignment 4. Vibration noise from relief valve	1. See above "NPSH too low". Check to see if head is set too high, suction line or valves and filter are clogged. 2. Check and, if necessary, renew 3. Check alignment 4. Increase spring pressure. Repair or renew relief valve.
Pump experiences faster-than-normal wear	1. Foreign matter in pumped fluid 2. Operating range exceeded (excessive noise development), Misalignment	1. Install filter; Check materials selected. Contact Varisco 2. Correct pump alignment.

Trouble	Potential Causes	Trouble shooting
Drive gets hot or is overloaded	Incorrectly designed delivery, delivery pressure	Check the piping Contact the manufacturer
High containment shell temperature	Excessive viscosity Product flow for cooling interrupted	Contact the manufacturer Check filter and design
High casing temperature	Foreign matter in pumped fluid Pump running dry Relief valve spring broken Fluid temperature too high Insufficient delivery rate Magnetic drive desynchronised	Reduce delivery head or delivery.

Disassembly of the V-Series Internal Gear Pump with Magnetic Coupling

9. Disassembly

9.1 General

Improper or incorrect assembly and disassembly may cause pump malfunctions and result in high repair costs and long downtimes. If you have questions or require further information, please do not hesitate to contact VARISCO S.p.A.

! *Failure to observe these instructions and/or the warning notes may result in risks to the operator and/or serious damage to the pump or pump unit.* VARISCO S.p.A.*shall not be held liable for any accidents or damage caused as a result of non-observance of this manual.*

The specific safety requirements in relation to strong magnetic fields must be strictly observed.

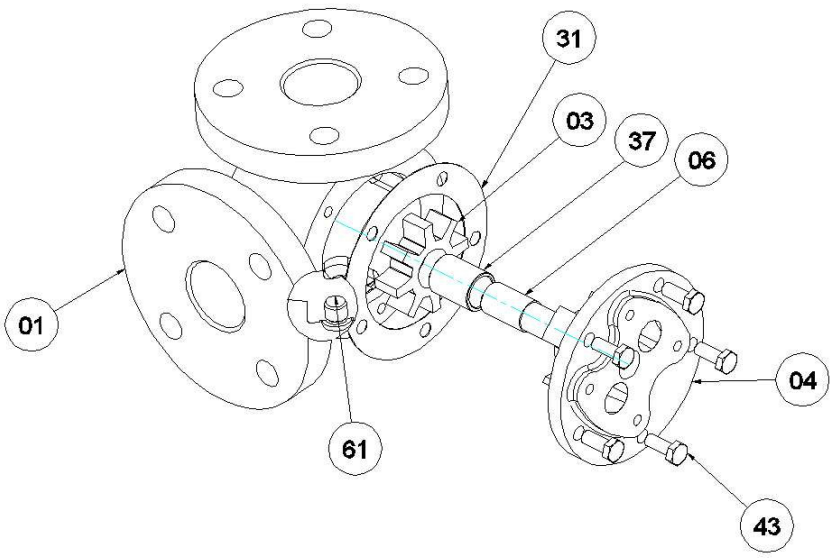
Persons who have a pacemaker should not be allowed to work on a pump with magnetic coupling! The magnetic field is sufficiently strong to affect a pacemaker's proper operation. For this reason, a safe distance of at least three (3) metres should be kept.

Always keep equipment with magnetic data carriers (memory) such as cheque cards, computer disks, watches, etc. at a distance from the magnetic coupling (at least 1 m) because they might be damaged and/or data loss might occur.

Prior to opening the pump, make sure that

- it is completely depressurized
- all its content was drained and the pump flushed
- it was vented and allowed to cool down.

9.2 **Disassembly of the pump cover (04)**



Remove the screws (43). Where present, use the two threaded bores to facilitate removal. When removing the cover (04) make sure that the seal (31) will not be damaged. If damaged, replace it.

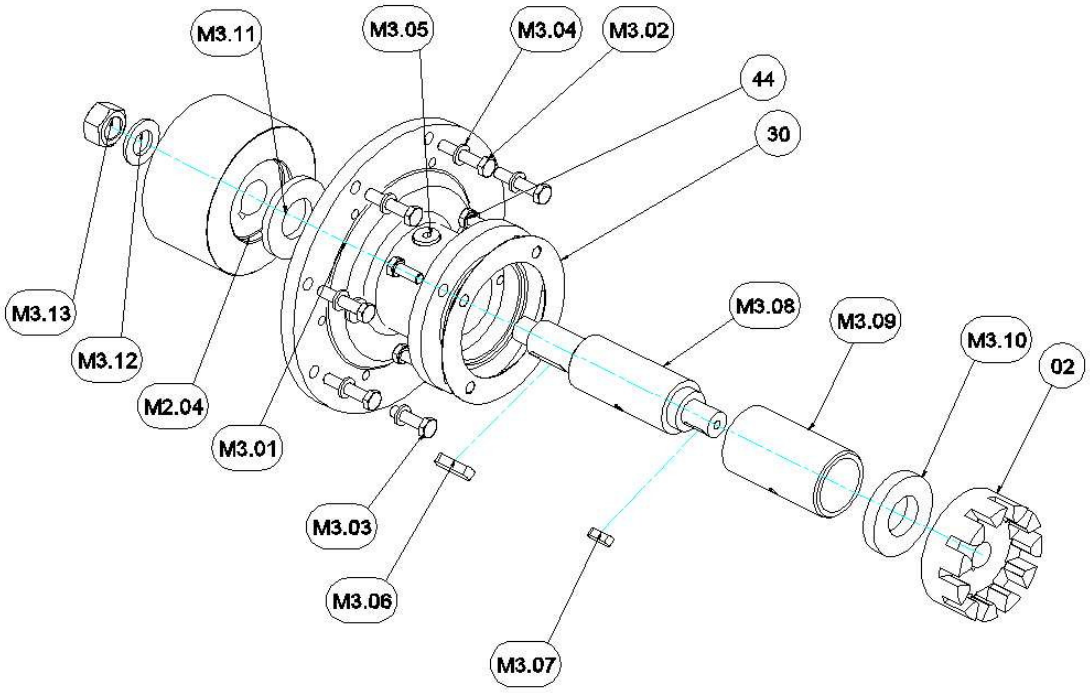
! *This also applies to all other pump seals.*

Pull off the pinion (03) with pressed-in plain bearing (37) from the cover (04) via the pin (06).

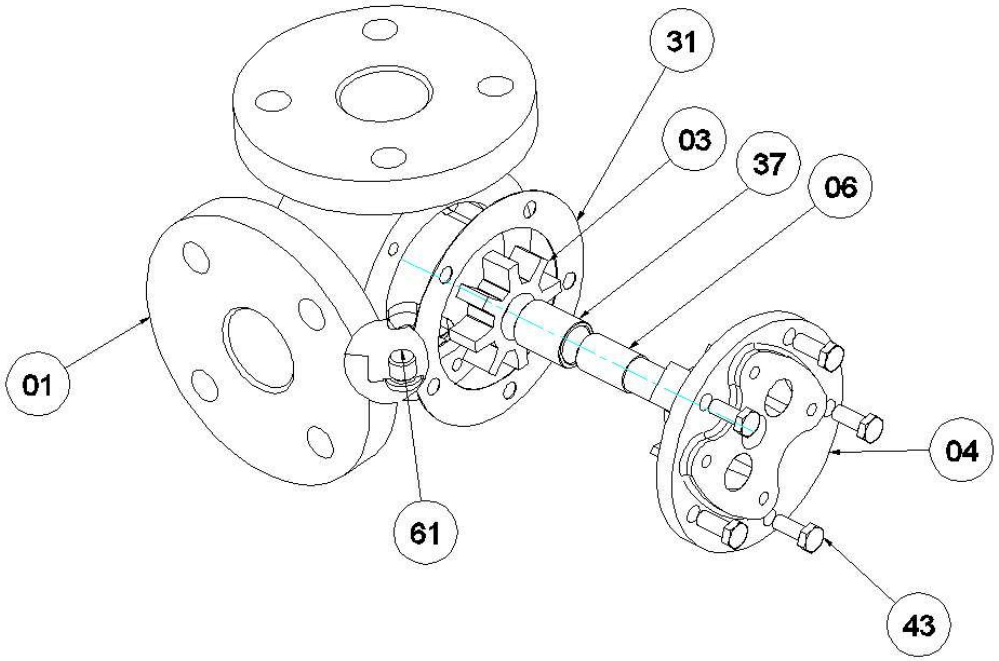
Heat the pinion (03) to approx. 80℃. When the temperature is high enough, the pinion's plain bearing (37) can be removed from the pinion (03).

Heat the pump cover to approx. 80℃. Press the pin out of its seat. Make sure that the pin is pressed out in the direction of the crescent.

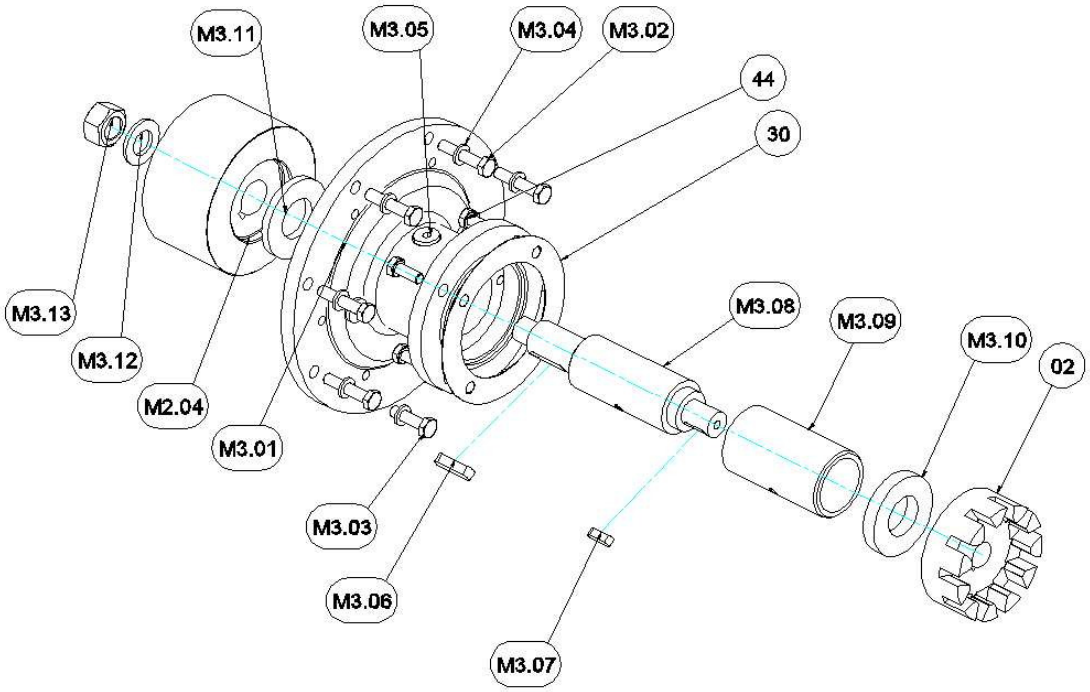
9.3 **Disassembly of the pump casing (01)**



Unscrew the screws (44) and pull-off the casing (01).



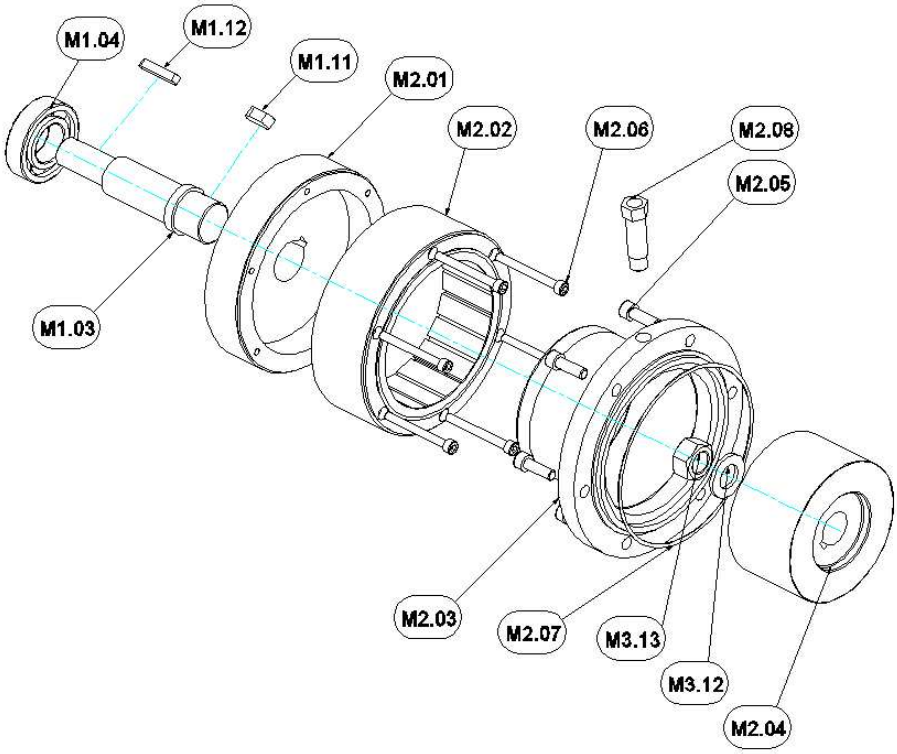
9.4 **Disassembly of the plug-in unit**



Unscrew the bolts (M3.02) and (M3.03) and pull-off the complete plug-in unit from the bearing bracket (M1.01).

! *On principle, the plug-in unit should only be separated from the external magnet (M2.02) by radial guidance (restricted guidance). Make sure that the external magnet (M2.02) and the containment shell (M2.03) do not get in contact. If they get in contact, the external magnet (M2.02) could be damaged. In such a case pump malfunction cannot be excluded.*

Remove the bolts (M2.05) and pull-off the containment shell (M2.03) from the intermediate flange (M3.01).



! *As regards the containment shell (M2.03), please remember that some remainders of the pumped fluid may still be in the pump. For safety instructions, please see the relevant media data sheet.*

Remove nut M18 (M3.13) and washer (M3.12) from the pump shaft (M3.08).

Separate the internal magnet (M2.04) from the pump shaft (M3.08) with the help of a suitable pull-off device.

Remove the thrust washer (M3.11) from the pump shaft (M3.08).

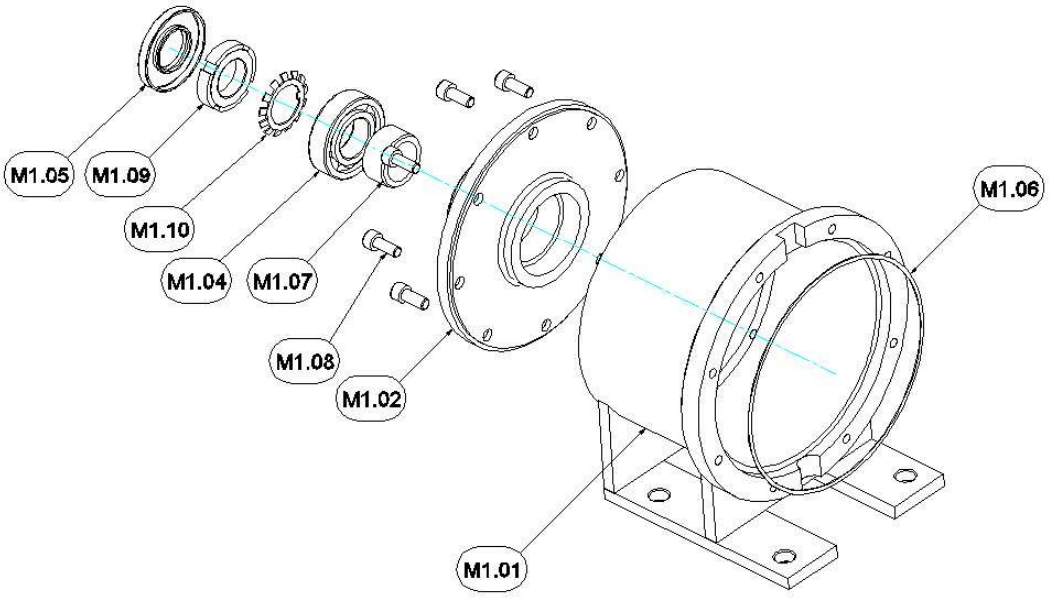
Pull-off the intermediate flange (M3.01) via the pump shaft (M3.08).

Heat the intermediate flange (M3.01) to approx. 80°C. Press-out the shaft slide bearing (M3.09) from the bearing seat.

Press out the pump shaft (M3.08) from the rotor (02).

! *Make sure that the thrust washer (M3.10) will not be damaged because it loosens when pump shaft (M3.08) and rotor (02) are pressed out.*

9.5 Disassembly of the bearing bracket



Remove the feather key (M1.12) from the drive shaft (M1.03).

Remove the shaft sealing ring (M1.05), the slotted nut (M1.09) and the safety plate (M1.10) from the drive shaft (M1.03).

Press out the external magnet (M2.02) and the drive shaft (M1.03) with magnet hub (M2.01) from the bearing bracket (M1.01) in the direction of the external magnet (M2.02).

Unscrew the bolts (M1.08) and dismantle the ball bearing cover (M1.02) from the bearing bracket (M1.01).

Remove the ball bearing (M1.04) from the ball bearing cover (M1.02).

Unscrew the screws (M2.06) and separate the external magnet (M2.02) from the magnet hub (M2.01).

Press out the drive shaft (M1.03) from the magnet hub (M2.01) in the direction of the feather key (M1.12).

Remove the ball bearing (M1.04) from the drive shaft (M1.03).

9.6 **Adjusting the axial play**

! *The axial play is dependent on the viscosity and can be adjusted through various thicknesses of the cover or the casing seal. Please see the table below for further information.*

Class	Pump type			
	V25-2 **V30-2**	**V50-3** **V60-2** **V70-2** **V80-2**	**V85-2**	**V100-2**
1	*0.2 mm*	*0.2 mm*	*0.3 mm*	*0.5 mm*
2	*0.3 mm*	*0.5 mm*	*0.7 mm*	*0.7 mm*
3	*0.5 mm*	*0.7 mm*	-	*1.0 mm*

Pump type		Viscosity
Stainless steel	**Grey cast iron**	
Class 2	*Class 1*	*up to 600 cSt and up to 180°C*
Class 3	*Class 2*	*from 600 to 6000 cSt and up to 180°C*
Class 3	*Class 3*	*over 6000 cSt and over 180°C*

Annex

Certificate of No Objection

We, the undersigned, submit the following pump and pump accessories for repair / inspection:

Type: .....

Specification: ....,. .....

Series no..:.. ... .

Cause of inspection/repair order:

P l e a s e note:

This certificate must be filled out and enclosed with any shipment for repair purposes to ensure proper handling of the pump.

The pump and/or pump accessories:

has/have not been used to pump any liquids that are harmful to health;

was/were used for (type of use).....

was/were in contact with liquids subject to labelling requirements under the law on

hazardous substances and/or dangerous goods. If known, please state the last medium

pumped: .....

Prior to shipment / provision the pump has been carefully drained and cleaned both inside and outside with a suitable cleaning agent.
No special safety precautions are required for further handling.
The following safety precautions are required in relation to flushing fluids, residual fluids and disposal:

We, the undersigned, confirm that the information provided above is correct and complete and shipment is in compliance with legal regulations.

Company:
Department:
Contact:
Phone:
Fax:
Address:
Street:
Postal code / town

.....

Place / date / company stamp / signature

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