œrlikon
leybold vacuum

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Excerpt from the Oerlikon Leybold Vacuum Full Line Catalog 2015/2016
Catalog Part Oils / Greases / Lubricants

Oils / Greases / Lubricants

LEYBONOL

Notizen

Contents

Oils / Greases / Lubricants

General

Products

Miscellaneous

General

Excellent Vacuum Performance

LEYBONOL has been specially developed to achieve the best possible ultimate pressure capable for your pump. It also provides a low vapor pressure over the entire vacuum range. LEYBONOL keeps your production running!

Long Lifetime

Vacuum suitable additives protect your pump and extend its life expectancy. LEYBONOL allows long oil change intervals helping to substantially reduce your maintenance costs.

Superior Lubrication

LEYBONOL reduces wear and tear caused by friction. Its superior lubrication properties reduce overall power consumption while also allowing for easy start ups.

Extensive Quality Controls

LEYBONOL oils are subjected to frequent on-going and rigorous testing to ensure that each batch is consistent and will provide the same outstanding vacuum performance.

Highest Industry Standards

LEYBONOL meets the highest industry standards such as

- RoHS - Conformity
- Freedom of VOC (Volatile Organic Compounds)
- BAM Registration (for some LEYBONOL products)
  (BAM = Bundesanstalt für Materialforschung und -prüfung)
- NSF H1 (NSF International / Nonfood Compounds Registration Program)
  (some products from the LEYBONOL line are NSF registered)

LEYBONOL® Lubricant Classifications

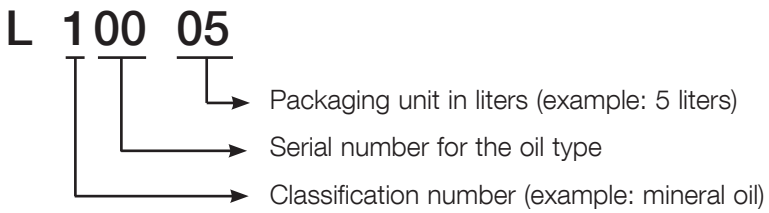
LVO 1XX	=	Mineral oil
LVO 2XX	=	Ester oil
LVO 3XX	=	PAO oil (Polyalfaolefins)
LVO 4XX	=	PFPE oil (Perfluoropolyether)
LVO 5XX	=	Diffusion pump oil
LVO 7XX	=	Special lubricants
LVO 8XX	=	Greases
LVO 9XX	=	Services / analyses

Self-explanatory part numbers

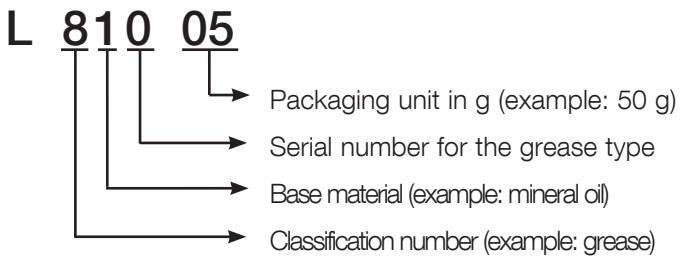
Example for LVO 100

L 100 **01**	=	1 liter
L 100 **05**	=	5 liters
L 100 **20**	=	20 liters
L 100 **99**	=	208 liters (drum)

Example 1: mineral oil, No. 00, 5 liters



Example 2: grease, based on mineral oil, No. 0, 50 g



Vacuum Pump Oils

LEYBONOL lubricating oils for vacuum pumps need to fulfil demanding requirements. Their vapor pressure must be low at high temperatures and the water content and water uptake must be minimal. Their viscosity characteristics need to be flat; lubricating properties need to be excellent and they need to be resistant against thermal decomposition and increased mechanical stress.

All the LEYBONOL oils listed in the following have been subjected in our factory laboratories to very comprehensive tests closely resembling the conditions encountered in practice by the respective pump series.

Under vacuum engineering conditions lubricating oils may react very differently compared to what is being expected of them.

In order to ensure the best possible performance of the vacuum pumps, the use of LEYBONOL vacuum pump oils qualified by Oerlikon Leybold Vacuum is recommended.

When using third party oils, the oil change intervals and the performance of the vacuum pump may be reduced. Also unwanted deposits may occur which may cause severe damage to the vacuum pump.

Our oils are subjected to an involved qualification process with respect to their technical suitability in our vacuum pumps.

Our warranty commitment is dependent on the usage of lubricating oils which are specifically qualified by us.

No liability will be assumed for any kind of damage caused through the usage of types of oil which have not been qualified or which are unsuitable.

In order to adapt the pumps to the different applications of our customers, different types of oil are used in our vacuum pump series.

Please note that owing to differing properties not all types of oil may be used in all our vacuum pump series. If you can not find the combination of pump and oil you require by way of a Part No., please ask us for a quotation.

Oil Types

Mineral Oils (LEYBONOL LVO 1XX)

Mineral oils are products distilled and refined from crude oil. These do not consist of precisely defined constituents but rather consist of a complex mixture. The way in which the mineral oil is pre-treated and its composition is decisive as to the applications it will be suited for. Depending on the distribution of the hydrocarbons and the dominance of certain properties, mineral oils are grouped according to paraffin-base, naphthenic and aromatic. For the purpose of attaining especially low ultimate pressures, mineral oils must be selected on the basis of a core fraction.

The thermal and chemical resistance of mineral oils has been found to be adequate in the majority of applications. They offer a high degree of compatibility with elastomers and resistance to hydrolysis.

Mineral oils also include the group of hydrocracked oils. These are frequently also termed semi-synthetic oils. Hydrocracked oils are produced under a very high hydrogen pressure at high temperature and are substantially free of aromatic compounds and olefins.

Hydrocracking oils exhibit a higher thermal stability compared to conventional mineral oils. In most cases the intervals between the oil changes can be extended.

Synthetic Oils

Synthetic oils are produced through chemical reactions. The group of synthetic oils includes liquids differing widely as to their chemical structure and composition. Correspondingly, their physical and chemical properties differ considerably. Synthetic oils are used in those cases where special properties of the oil are required which can not be fulfilled by mineral oils.

Synthetic oils are among others:

Ester Oils (LEYBONOL LVO 2XX)

Ester oils are organic compounds which excel especially through their high thermal resistance to cracking compared to mineral oils. Chemical resistance is generally quite good, but will depend on the type of ester oil. Elastomer compatibility and resistance against hydrolysis are not so good compared to mineral oils.

They should not be used when pumping acids, halogens or alkaline media like ammonia in connection with humidity.

Polyalfaolefins (PAO) (LEYBONOL LVO 3XX)

Polyalphaolefin oils are synthetic hydrocarbons which are paraffin like, but have a uniform structure. Thermal and chemical resistance is better compared to mineral oils.

Owing to their good flowing properties when cold they can be used at low temperatures.

Elastomer compatibility and resistance against hydrolysis are comparable to mineral oils.

Perfluoropolyether (PFPE) (LEYBONOL LVO 4XX)

These are oils which are only composed of carbon (C), fluorine (F) and oxygen (O) atoms. The existing

C-O and C-F bonds are highly stable. For this reason PFPE oils are practically inert against all chemical and oxidizing influences.

Perfluoropolyethers will not polymerise under the influence of high energy radiation.

Perfluoropolyethers are used when pumping strongly oxidative substances like oxygen, ozone or nitric oxides as well as highly reactive substances like halogens and hydrogen halides. Regarding Lewis acids (for example, boron trifluoride BF_3, aluminium trichloride $AlCl_3$) they are not completely inert. Here reactions may take place at temperatures over approximately 150 °C (302 °F).

Perfluoropolyethers are thermally highly stable. PFPE is not flammable. Thermal decomposition may only take place at temperatures of over 290 °C (554 °F).

Caution: perfluoropolyethers will – when decomposed – release toxic and corrosive gases: hydrogen fluoride HF, carbonyl difluoride COF_2 among others. For this reason open fires must be avoided in the workspace where PFPE is being used. Do not smoke in the workspace where PFPE is being used.

Only suitably prepared pumps must be used in connection with perfluoropolyethers, since it is essential that these be free of hydrocarbons.

Changing from one basic type of oil to PFPE must be left exclusively to authorised Service Centers. The pumps will have to be fully disassembled and carefully cleaned. Gaskets and filters will have to be exchanged and suitable greases will have to be used.

Other Types of Synthetic Oil

Further types of synthetic oil like polyglycols, phosphate esters or silicone oils are not recommended by us for our forevacuum pumps. These types of oil exhibit specific properties which may have a negative effect when used in forevacuum pumps.

Safety data sheets are available to professional users from:
e-mail “documentation.vacuum@oerlikon.com” or Internet “www.oerlikon.com/leyboldvacuum”.

Diffusion Pump Oils

Pump fluids for oil diffusion pumps must exhibit a low vapor pressure at room temperature and must be able to resist thermal decomposition and oxidization to a large extent. Surface tension of the pump fluids must be high to reduce creep of oil films. They must be chemically inert, exhibit a high flash point and evaporation heat must be low. Moreover, the pump fluids should permit high pumping speeds over a wide range of pressures and be cost effective.

One type of pump fluid alone cannot meet these comprehensive requirements.

It is therefore required to select a pump fluid according to the operating pressure and the requirements of the application in each case.

Mineral oils (LEYBONOL LVO 500 and LVO 510)

Mineral oils for diffusion pumps are closely toleranced fractions of a high quality base product distilled with particular care.
These pump fluids are especially suited for work in a high vacuum.

Silicone oil (LEYBONOL LVO 520 and LVO 510)

Silicone oils are composed of precisely defined chemical compounds and are highly resistant. Owing to their extremely low vapor pressure, silicone oils are particularly well suited as a working fluid. Even after numerous air inrushes, silicone oils suffer neither ageing nor mass spectrometrically apparent alterations.
Strong mineral acids, alkalis and strong oxidants are capable of decomposing silicone oils.

(LEYBONOL LVO 540) is a hydrocarbon compound

LVO 540 has been developed for utilisation in oil vapour jet pumps.
It is thermally and chemically highly resistant and excels through a high degree of oxidation resistance.
It delivers the essential high pumping speed of the vapour jet pumps in the medium vacuum range.

Safety data sheets are available to professional users from:
e-mail “documentation.vacuum@oerlikon.com” or Internet “www.oerlikon.com/leyboldvacuum”.

Special Lubricants

(LEYBONOL LVO 7XX)

All special lubricants are summarised under the name of LEYBONOL LVO 7xx which are used in connection with special applications.

For example, LEYBONOL LVO 700 is a H1 registered, extremely stable special lubricant for vacuum pumps. This special lubricant has been developed for special applications where reactions with chemically active substances cannot be avoided.

Greases

(LEYBONOL LVO 8XX)

Greases are solid to semi-solid substances which consist of the principal components base oil and thickener.

The base oil provides most of the lubrication and will in most cases define the service temperature. The thickener binds the oil and can increase the lubricity or the thermal stability of the grease.

Added to these two constituencies are additives which may improve the performance of the grease in specific areas depending on the specific application.

As base oils, frequently mineral oils, synthetic oils on the basis of ester oils, PAOs, silicone oils or also PFPE (perfluoropolyethers) are used.

Thickeners are roughly categorised in soap thickeners like lithium, for example and non-soap thickeners like polyurea or PTFE.

Greases will reduce friction and wear, ensure moveability of components, will seal off against contaminants or are used as anti-rust and anticorrosion agents.

Through the selection of corresponding base oil types, thickeners and additives, greases can be optimised for different applications.

Safety data sheets are available to professional users from:
e-mail “documentation.vacuum@oerlikon.com” or Internet “www.oerlikon.com/leyboldvacuum”.

General Information and Recommendations for Oils

Lubricant Functions

The term “Lubricant” actually describes only one of the five important functions of the oil:

Lubrication

Oil is used as a **lubricant** helping to reduce friction and provide a protective film against mechanical wear.
For example, the vanes of a vacuum pump are forced by the centrifugal force against the pump ring at a force of several Newtons. The oil protects the vanes against friction since they slide along on the oil film. When viewing a running pump from the inside using stroboscopic light it is apparent how an oil wave builds up in front of the vanes, pressing the vanes away from the pump ring. The vanes never touch the pump ring or the bearing covers allowing the pump to operate for 10,000s of hours.

Cooling

The oil conducts the heat produced by friction and gas compression away so that the pump will always be operated at its optimum operating temperature. The oil here functions as a coolant.

Means of transport (dispersing properties of oils)

As a **means of transport** the oil absorbs process substances or other particles keeping them suspended (dispersed). In this way pump sections are protected against suffering damage. Sludge deposits and oil thickening shall be avoided.

Corrosion Protection

The oil shall protect the inner pump surfaces against corrosion. Corrosion can occur when the pump is used to pump water vapor or other chemical vapours which condense. The oil wets and protects the inner pump surfaces helping to keep condensate away from these. The oil acts as a **corrosion inhibitor**.
Applies only to a lesser extent to PFPE (LVO 4XX).

Sealing

As a **sealing agent** oil improves the attainable ultimate pressure and the attainable pumping speed. This is the principal function of vacuum pump oil. Oil sealed pumps are capable of attaining a much improved ultimate pressure compared to oil-free rotary vane pumps of similar construction.

In oil sealed pumps an oil film is created on the guiding components as well as on the tips and sides of the vanes.

The oil seals the intermediate spaces around the edges and tips of the vanes thereby preventing gas molecules from flowing back through leaks.

This improves the attainable ultimate pressure and the attainable pumping speed within all pressure ranges.

Oil Lifetime

Oil lifetime is dependent on a number of parameters.

An important influencing factor is that of the temperature. Mineral oils are commonly specified for a maximum temperature limit of 80 °C (176 °F). Above this temperature, to put it simply, it can be said that a temperature increase by 10 °C (50 °F) will cut oil lifetime in half. This results in thickening of the oil.

Synthetic oils may depending on the type be operated constantly at 100 to 160 °C (320 °F). PFPE oils can be operated constantly at a temperature of 250 °C (482 °F) max., however, lower maximum temperatures need to be taken into account depending on the process medium.

PFPE oils are not subject to any typical oil ageing since they are almost inert (for this see also the chapter “Vacuum Pump Oils”, paragraph Perfluoropolyethers PFPE).

When operating a pump under conditions which are too cold, then water vapor or other vapours may condense. The condensed liquid may then cause a loss of the lubricating properties or cause corrosion within the pump.

The following parameters among others have a direct influence on the oil temperature:

- Ambient temperature
- Operating pressure
- Operating frequency 50 or 60 Hz
- Temperature of the pumped gases
- Gas ballast type and flow
- Water or air cooling
- Cooling water temperature and condition of the cooling water circuit
- Oil volume

A further important factor regarding oil lifetime is the avoidance of influences which have a modifying effect on the oil like the ingress of reactive or ag-gressive substances, water vapor, dust or contaminants in general.

For dispersion of process media and cleaning of the oil by oil filters, we offer a number of different standard approaches.
Please contact us.

Our experts shall be pleased to assist you in the selection process for suitable accessories (for this refer also to paragraph “Oil Cleaning”).

Oil Check

The condition of the oil can be determined by way of an oil analysis.

Assessing the colour of the oil alone does not indicate the condition of the lubricant in a conclusive way. Colour changes and a turbid appearance of the oil can be indicative of contamination with foreign substances or oxidation. A turbid appearance may be indicative of water, for example. Depending on the type of oil a dark discolouration of the oil can occur already after a few operating hours, but without any negative effects on the application as in the case of LVO 210, for example.

For this reason only a comparison between the fresh oil and the used oil through an analysis will help (see chapter “Services”). For the purpose of detecting a necessary oil change, viscosity and the neutralisation number (TAN - total acid number) are analysed in comparison with fresh oil.

Changes in viscosity exceeding 20% necessitate an oil change. If the neutralisation number (TAN) in the case of mineral oils and PAOs increases to a level of 2 mg KOH/g then an oil change should be done. Above this value ageing of a mineral oil or PAO will increase exponentially.

In the case of ester oils, a higher neutralisation number can be accepted since here oil ageing will not be exponential. However, this requires that trend analyses confirm a low increase and that the other oil data be inconspicuous.

Oil Cleaning

Oerlikon Leybold Vacuum offers a number of different standard oil filter devices.

These include:

- Mechanical oil filters for depositing dust, crystalline decomposition products and sludge
- Chemical oil filters for separating substances dissolved in the oil by way of adsorption to activated aluminium oxide
- Various separators for the intake side for avoiding the ingress of process media into the pump

Please contact us.
Our experts shall be pleased to assist you in the selection process for suitable accessories.
Details on the respective pump accessories and additional information can also be found in the corresponding Catalog Part.

Oxygen Applications

In applications in which pure oxygen or oxygen concentrations exceeding that in the atmosphere (over 21% by volume) occur, suitable operating means must be used.

Oxygen reacts with hydrocarbons. In connection with mineral oil based lubricants and most synthetic oils there exists an ignition risk. Oxygen can cause a self-ignition of oils and greases.

Even a slight oxygen enrichment may have the following effects:

- Increase in the rate of combustion
- Combustion temperature increase
- Decreased ignition temperature

For this reason any oxygen concentration above that of the atmosphere needs to be considered as hazardous.

In such cases a perfluouropolyether (PFPE) will be suitable as the operating agent.
Oerlikon Leybold Vacuum has in its product range special vacuum pumps specified for PFPE operation which are free of hydrocarbons.

Information for Smooth Operation

- Reactive or aggressive substances in the pumped flow can inadmissibility stress the operating oil or modify it and may even be incompatible with the materials of the pump
- Even small quantities of dust or particles can result in failures
- Pumping of liquids is not permissible
- Corrosion, deposits and severe oil cracking can cause a pump failure
- Avoid standstill corrosion of the pumps for all processes which involve condensable vapours
- Small quantities of water may be ejected safely by operating the pumps with their gas ballast
- Avoidance of oil modifying influences or incresed number of oil

change intervals adapted to the specific application

- Selection of the optimum lubricant type and optimum viscosity
- Regular checks on the oil condition and the filters
- Pump maintenance in regular intervals
- Keep thermal stresses low
- Oil cleaning by oil filters and separation of process media

Moreover, all safety regulations regarding explosion protection need to be observed.

Storage of LEYBONOL Oils and Greases

Important recommendations for **proper** storing all LEYBONOL lubricants are:

- Storage temperature +10 to +30 °C (+50 to +86 °F)
- The containers should be protected against direct sunlight
- Drums should be stored horizontally
- Storage in enclosed indoor rooms
- The storage rooms should be clean and dry

LEYBONOL Oils

When stored properly in sealed original containers, the following durability periods apply:

The product LEYBONOL LVO 240 exhibits a durability of two years.

For the PFPE products LEYBONOL LVO 4XX a durability of 20 years applies.
For the other LEYBONOL oils durability is at least 3 years.

Restrictions

For sealed original containers: if the product is not stored properly, durability is reduced.

After the containers have been opened: Adequate precautions against the ingress of dust, dirt, water etc. need to be introduced and the contents must be used up speedily. After having opened the containers once, durability of the product is reduced.

LEYBONOL Greases

Durability of the LEYBONOL greases differs widely depending on their type. For this reason no general statement can be made.

Upon request we shall be pleased to send to you precise durability information on the individual LEYBONOL lubricants.

LEYBONOL Mineral Oils

Application Data	LVO 100	LVO 110
Type of oil	Mineral oil, free of additives	Hydrocracked mineral oil with additives
Properties	Low vapor pressure, low inclination to foaming very good water separation	Significantly increased oil change intervals, high thermal stability, low inclination to foaming
Application examples	Standard oil for low ultimate pressures. Pumping of air, chemically inert gases and water vapor	Backing pumps for mass spectrometers. Pumping of air or chemically inert gases
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [1] EPDM	 Suited Conditionally suited Unsuitable	 Suited Conditionally suited Unsuitable
Used in the pumps of series	TRIVAC, E + DK, RUVAC	SOGEVAC (≤ SV 65 A and ≤ SV 120 BI (FC)

Technical Data		LVO 100	LVO 110
ISO viscosity grade		ISO VG 100	ISO VG 32
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 95 10.5	 32 5.5
Flash point	°C (°F)	> 255 (> 491)	238 (460)
Density at 15 °C (59 °F)	kg/m^3	880	841
Pour point	°C (°F)	< -9 (< +16)	-33 (-27)

Ordering Information	LVO 100	LVO 110
	Part No.	Part No.
1 liter	L 100 01	L 110 01
2 liters	–	L 110 02
5 liters	L 100 05	–
20 liters	L 100 20	–
208 liters	L 100 99	–

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected.
The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

Application Data	LVO 120	LVO 130
Type of oil	Mineral oil with additives	Mineral oil with additives
Properties	Extended oil change intervals, low inclination to foaming, very good water separation	Extended oil change intervals, low inclination to foaming, very good water separation
Application examples	Standard oil for small SOGEVAC pumps [1] Pumping of air, chemically inert gases and water vapor	Standard oil for large SOGEVAC pumps [1] Pumping of air, chemically inert gases and water vapor
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [2] EPDM	 Suited Conditionally suited Unsuitable	 Suited Conditionally suited Unsuitable
Used in the pumps of series	**SOGEVAC A-series (≤ SV 65) and B-series (≤ SV 25, ≤ SV 120 BI (FC))**	**SOGEVAC A-series (≥ SV 100) and B-series (≥ SV 40 B)**

Technical Data		LVO 120	LVO 130
ISO viscosity grade		ISO VG 32	ISO VG 68
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 32 5.5	 68 9
Flash point	°C (°F)	244 (471)	248 (478)
Density at 15 °C (59 °F)	kg/m^3	875	885
Pour point	°C (°F)	-27 (-17)	-21 (-6)

Ordering Information	LVO 120	LVO 130
	Part No.	**Part No.**
0.5 liters	**L 120 00**	**–**
1 liter	**L 120 01**	**L 130 01**
2 liters	**L 120 02**	**L 130 02**
5 liters	**L 120 05**	**L 130 05**
20 liters	**L 120 20**	**L 130 20**
208 liters	**–**	**L 130 99**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] LVO 120 is suited for the SOGEVAC SV 25 B and smaller pumps where the lower viscosity assists the starting process.
LVO 130 is suited for the SOGEVAC SV 40 B and larger pumps where the higher viscosity assists attaining of lower pressures.
However, all SOGEVAC pumps can be operated with both types of oil and moreover, LVO 120 and LVO 130 can be mixed with each other.

[2] Resistance is dependent on the level of the acrylonitrile content in the NBR

Application Data	LVO 140	LVO 150
Type of oil	Mineral oil with additives	Mineral oil with additives
Properties	H1 registration by NSF. Constituents approved by the FDA under CFR 178.3570. In acc. with USDA-H1	H1 registration by NSF. Constituents approved by the FDA under CFR 178.3570. In acc. with USDA-H1
Application examples	Recommended for applications in the food industry	Recommended for applications in the food industry
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [1] EPDM	 Suited Conditionally suited Unsuitable	 Suited Conditionally suited Unsuitable
Used in the pumps of series	**SOGEVAC A-series (≤ SV 65) and B-series (≤ SV 25 B)**	**SOGEVAC A-series (≥ SV 100) and B-series (≥ SV 40 B)**

Technical Data		LVO 140	LVO 150
ISO viscosity grade		ISO VG 32	ISO VG 68
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 30 5	 63 8
Flash point	°C (°F)	225 (437)	253 (487)
Density at 15 °C (59 °F)	kg/m^3	860	870
Pour point	°C (°F)	-18 (-0.4)	-18 (-0.4)

Ordering Information	LVO 140	LVO 150
	Part No.	**Part No.**
1 liter	**L 140 01**	**L 150 01**
20 liters	**–**	**L 150 20**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected.
The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

Application Data

	LVO 160
Type of oil	Hydrocracked mineral oil with additives
Properties	Significantly increased oil change intervals, high thermal stability,low inclination to foaming
Application examples	Pumping of air or chemically inert gases
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [1)] EPDM	 Suited Conditionally suited Unsuitable
Used in the pumps of series	SOGEVAC A-series (≥ SV 100) and B-series (≥ SV 40 B)

Technical Data

		LVO 160
ISO viscosity grade		ISO VG 68
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 68 9
Flash point	°C (°F)	254 (489)
Density at 15 °C (59 °F)	kg/m^3	862
Pour point	°C (°F)	254 (489)

Ordering Information

	LVO 160 Part No.
1 liter	L 160 01

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected.
The technical data stated here do not entail any warranted characteristics

[1)] Resistance is dependent on the level of the acrylonitrile content in the NBR

LEYBONOL Ester Oils

Application Data	LVO 200	LVO 210
Type of oil	Synthetic oil (ester oil with additives)	Synthetic oil (ester oil with additives)
Properties	Very high thermal, oxidative and chemical stability, good deterging/dispersion characteristics, excellent wear protection	Very high thermal, oxidative and chemical stability, good deterging/dispersion characteristics, excellent wear protection
Application examples	Application at increased temperatures	Application at increased temperatures
	Starting of the pump between 0 and +12 °C (32 and 64 °F) Pumping of air, inert gases, carbon dioxide (dry), carbon monoxide, organic solvent vapours, resin vapours	Pumping of air, inert gases carbon dioxide (dry), carbon monoxide, organic solvent vapours, resin vapours
Remarks	Not for pumping of inorganic acids, free halogens or alkaline media	Not for pumping inorganic acids, free halogens or alkaline media
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [1] EPDM	 Suited Conditionally suited Unsuitable	 Suited Conditionally suited Unsuitable
Used in the pumps of series	**SOGEVAC A-series (≤ SV 65 A) and BI-series (≤ SV 120 BI (FC)**	**TRIVAC B, SP-Line, E + DK, RUVAC, DRYVAC, SOGEVAC (≥ SV 100, ≥ SV 40 B) SV 40 Cat. 1 (i)/2 (o) IIB + H2 and SV 40 B to 630 B Cat. 2 (i)/2 (o) and 3 (i)/3 (o)**

Technical Data		LVO 200	LVO 210
ISO viscosity grade		ISO VG 32	ISO VG 100
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 28 5.5	 97 9
Flash point	°C (°F)	258 (496)	250 (482)
Density at 15 °C (59 °F)	kg/m^3	918	960
Pour point	°C (°F)	< -45 (< -49)	-33 (-27)

Ordering Information	LVO 200	LVO 210
	Part No.	**Part No.**
1 liter	**L 200 01**	**L 210 01**
2 liters	**L 200 02**	**L 210 02**
5 liters	**L 200 05**	**L 210 05**
20 liters	**L 200 20**	**L 210 20**
208 liters	**–**	**L 210 99**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

Application Data	LVO 220	LVO 240
Type of oil	Synthetic oil (ester oil with additives)	Synthetic oil (special ester oil)
Properties	Very high thermal, oxidative and chemical stability, good deterging and dispersion characteristics, excellent wear protection	Excellent solubility for polymers
Application examples	Application in RUVAC WSLF for operation with gas lasers	Pumping of process media which have a tendency to polymerise (styrene and butadiene)
Remarks		Do not use any chemical oil filters Strictly avoid any mixing with any other type of oil Not for pumping inorganic acids
Elastomer compatibility **FKM (FPM, Viton)** **NBR (Perbunan)** [1] **EPDM**	 Suited Conditionally suited Unsuitable	 Suited Unsuitable Unsuitable
Used in the pumps of series	**RUVAC (WSLF)**	**TRIVAC B**

Technical Data		LVO 220	LVO 240
ISO viscosity grade		ISO VG 100	Not classified
Viscosity			
at 40 °C (104 °F)	**mm^2/s**	94	38
at 100 °C (212 °F)	**mm^2/s**	13	5
Flash point	**°C (°F)**	265 (509)	225 (437)
Density at 15 °C (59 °F)	**kg/m^3**	915	1055 [2]
Pour point	**°C (°F)**	-35 (-31)	-32 (-26)

Ordering Information	LVO 220	LVO 240
	Part No.	**Part No.**
1 liter	**L 220 01**	**–**
20 liters	**–**	**L 240 20**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR
[2] At 20 °C (68 °F)

Application Data

	LVO 250	LVO 260
Type of oil	Synthetic oil (ester oil with additives)	Synthetic oil (special ester oil)
Properties	High thermal and oxidative stability	Very high thermal and oxidative stability
Application examples	Bearing lubricant for turboradial blowers	Bearing lubricant for turboradial blowers
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [1] EPDM	 Suited Conditionally suited Unsuitable	 Suited Conditionally suited Unsuitable
Used in the pumps of series	TURBOSTREAM	TURBOSTREAM

Technical Data

		LVO 250	LVO 260
ISO viscosity grade		Not classified	Not classified
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 13 3.5	 24 5
Flash point	°C (°F)	> 185 (> 365)	245 (473)
Density at 15 °C (59 °F)	kg/m^3	925	980 [2]
Pour point	°C (°F)	< -57 (< -71)	-60 (-76)

Ordering Information

	LVO 250	LVO 260
	Part No.	**Part No.**
0.3 liters	**L 250 00**	**L 260 00**
300 ml Set (for TURBOSTREAM D 2500	**896 101**	**–**
600 ml Set (for TURBOSTREAM D 2500 / S 3500)	**–**	**896 112**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

[2] At 20 °C (68 °F)

LEYBONOL PAO Oils

Application Data	LVO 300	LVO 310
Type of oil	Synthetic oil (PAO with additives)	Synthetic oil (PAO with additives)
Properties	High thermal and oxidative stability	High thermal and oxidative stability
	H1 registration by NSF. Constituents approved by the FDA under CFR 178-3570. In acc. with USDA - H1	
Application examples	Recommended for applications in the food industry Backing pumps for mass spectrometers Cleaning systems	Cold starting at low temperatures is possible Pumping of air, chemically inert gases, water vapor and small quantities of refrigerant R 717 (ammonia)
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [1)] EPDM	 Suited Conditionally suited Unsuitable	 Suited Conditionally suited Unsuitable
Used in the pumps of series	**TRIVAC, SOGEVAC A-series (≥ SV 100) and B-series (≥ SV 40 B)**	**TRIVAC**

Technical Data		LVO 300	LVO 310
ISO viscosity grade		ISO VG 100	ISO VG 32
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 99 13.5	 29 5.5
Flash point	°C (°F)	270 (518)	230 (446)
Density at 15 °C (59 °F)	kg/m^3	840	820
Pour point	°C (°F)	-54 (-65)	< -54 (< -65)

Ordering Information	LVO 300	LVO 310
	Part No.	**Part No.**
0.5 liters	**L 300 00**	**–**
1 liter	**L 300 01**	**L 310 01**
20 liters	**L 300 20**	**–**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1)] Resistance is dependent on the level of the acrylonitrile content in the NBR

LEYBONOL PFPE Oils

Application Data	LVO 400	LVO 410
Type of oil	Synthetic oil (perfluoropolyether PFPE, free of additives)	Synthetic oil (perfluoropolyether PFPE, free of additives)
Properties	Chemically inert Highest thermal stability	Chemically inert Highest thermal stability
Application examples	Pumping of strong oxidants like oxygen, ozone or nitrous oxides, as well as reactive substances like halogens, hydrogen halides and conditionally Lewis acids	Pumping of strong oxidants like oxygen, ozone or nitrous oxides, as well as reactive substances like halogens, hydrogen halides and conditionally Lewis acids
Remarks	Use only in pumps modified for PFPE Mixing with any type of other oil must be strictly avoided Avoid pumping of water vapor, in particular in connection with corrosive media (see above) The use of a chemical oil filter CF/CFS is strongly recommended **When used in RUVAC:** For use with PFPE we exclusively recommend pump types with a canned motor	Use only in pumps modified for PFPE Mixing with any type of other oil must be strictly avoided Avoid pumping of water vapor, in particular in connection with corrosive media (see above) The use of a chemical oil filter CF/CFS is strongly recommended **When used in RUVAC:** For use with PFPE we exclusively recommend pump types with a canned motor
Elastomer compatibility		
FKM (FPM, Viton)	Suited	Suited
NBR (Perbunan) [1]	Suited	Suited
EPDM	Suited	Suited
Used in the pumps of series	**TRIVAC BCS, SOGEVAC, E + DK, RUVAC, LEYVAC**	**RUVAC, E + DK, DRYVAC**

Technical Data		LVO 400	LVO 410
ISO viscosity grade		Not classified	Not classified
Viscosity			
at 40 °C (104 °F)	mm^2/s	49	89
at 100 °C (212 °F)	mm^2/s	7	11
Flash point	°C (°F)	– [2]	– [2]
Density at 20 °C (68 °F)	kg/m^3	1890	1900
Pour point	°C (°F)	-45 (-49)	-35 (-31)

Ordering Information	LVO 400	LVO 410
	Part No.	**Part No.**
0.60 liters	**–**	**L 410 00**
0.75 liters	**L 400 00**	**–**
1 liter	**L 400 01**	**L 410 01**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

[2] **Caution:** in the case of thermal decomposition > 290 °C (> 554 °F) toxic and corrosive gases are released. When handling PFPE keep away from open fires. Do not smoke in the work area

Application Data

	LVO 420
Type of oil	Synthetic oil (perfluoropolyether PFPE, free of additives)
Properties	Chemically inert Highest thermal stability
Application examples	Pumping of strong oxidants like oxygen, ozone or nitrous oxides, as well as reactive substances like halogens, hydrogen halides and conditionally Lewis acids
Remarks	Use only in pumps modified for PFPE Mixing with any type of other oil must be strictly avoided Avoid pumping of water vapor, in particular in connection with corrosive media (see above) The use of a chemical oil filter CF/CFS is strongly recommended
Elastomer compatibility	
FKM (FPM, Viton)	Suited
NBR (Perbunan) [1]	Suited
EPDM	Suited
Used in the pumps of series	**SOGEVAC BI-series with 1 ph motors ≤ SV 40 BI**

Technical Data

		LVO 420
ISO viscosity grade		Not classified
Viscosity		
at 40 °C (104 °F)	**mm^2/s**	25
at 100 °C (212 °F)	**mm^2/s**	4.5
Flash point	**°C (°F)**	– [2]
Density at 20 °C (68 °F)	**kg/m^3**	1880
Pour point	**°C (°F)**	-50 (-58)

Ordering Information

	LVO 420
	Part No.
1 liter	**L 420 01**
2 liters	**L 420 02**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

[2] **Caution:** in the case of thermal decomposition > 290 °C (> 554 °F) toxic and corrosive gases are released. When handling PFPE keep away from open fires. Do not smoke in the work area

LEYBONOL Diffusion Pump Oils

Technical Data	LVO 500 (DIFFELEN normal)	LVO 510
Type of oil	White oil, free of additives	Mineral oil, free of additives
Properties	Good thermal stability	High thermal stability
Application examples	LVO 500 is the most frequently used pump fluid for applications in a high vacuum. The attainable ultimate total pressure is below 10^{-7} mbar	For applications in a high vacuum
Elastomer compatibility		
FKM (FPM, Viton)	Suited	Suited
NBR (Perbunan) [1]	Conditionally suited	Conditionally suited
EPDM	Unsuitable	Unsuitable
Used in the pumps of series	DIP, LEYBOJET 630	DIP, LEYBOJET 630

Technical Data		LVO 500 (DIFFELEN normal)	LVO 510
Vapor pressure at 20 °C (68 °F)	mbar	4×10^{-9}	1×10^{-7}
Viscosity at 40 °C (104 °F)	mm^2/s	100	60
Flash point	°C (°F)	> 250 (> 482)	> 230 (> 446)
Density at 20 °C (68 °F)	kg/m^3	868	850

Technical Data	LVO 500 (DIFFELEN normal)	LVO 510
	Part No.	Part No.
1 liter	L 500 01	L 510 01
5 liters	L 500 05	L 510 05
20 liters	L 500 20	–

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics.

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

Application Data	LVO 520	LVO 530
Type of oil	Silicone oil (tetramethyl-tetraphenyltrisiloxane)	Silicone oil (Pentaphenyltrisiloxane)
Properties	Very high thermal stability and highly resistant against oxidation and decomposition	Very high thermal stability and high resistance against oxidation and decomposition
Application examples	For high vacuum and ultra-high vacuum applications	For high vacuum and ultra-high vacuum applications involving very high thermal loads
Elastomer compatibility		
FKM (FPM, Viton)	Suited	Suited
NBR (Perbunan) [1]	Suited	Suited
EPDM	Suited	Suited
Used in the pumps of series	DIP, LEYBOJET 630	DIP, LEYBOJET 630

Technical Data		LVO 520	LVO 530
Vapor pressure at 20 °C (68 °F)	mbar	7×10^{-9} [2]	4×10^{-10} [2]
Viscosity at 40 °C (104 °F)	mm^2/s	21	175 [2]
Flash point	°C (°F)	221 (430)	245 (473)
Density at 20 °C (68 °F)	kg/m^3	1070 [2]	1090 [2]

Ordering Information	LVO 520	LVO 530
	Part No.	Part No.
1 liter	L 520 01	L 530 01
5 liters	L 520 05	–

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR
[2] At 25 °C (77 °F)

Application Data

	LVO 540
Type of oil	Pump fluid based on hydrocarbons
Properties	High thermal stability and excellent resistance against oxidation and decomposition
Application examples	For oil vapor jet pumps
Elastomer compatibility	
FKM (FPM, Viton)	Suited
NBR (Perbunan) [1]	Suited
EPDM	Unsuitable
Used in the pumps of series	OB

Technical Data

		LVO 540
Vapor pressure at 20 °C (68 °F)	mbar	6×10^{-6}
Viscosity at 40 °C (104 °F)	mm^2/s	22
Flash point	°C (°F)	196 (385)
Density at 20 °C (68 °F)	kg/m^3	885

Ordering Information

	LVO 540
	Part No.
20 liters	**L 540 20**
200 liters	**L 540 99**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

LEYBONOL Special Lubricants

Application Data	LVO 700	DOT 4
Type of oil	Synthetic cyclic hydrocarbon	Brake fluid
Properties	H1 registration by NSF. Very high thermal stability and highly resistant against oxidation and decomposition. Very long lifetime.	High-quality brake fluid based on glycol ethers. Corresponds to FMVSS DOT 4
Application examples	Chemically inert to gases of acidic nature. For long service intervals	Only for filling of brake fluid circuits in the automotive industry.
Remarks	–	Use only in pumps modified specifically for DOT 4. Mixing with any other type of oil must be strictly avoided
Elastomer compatibility FKM (FPM, Viton) NBR (Perbunan) [1] EPDM [2]	 Suited Conditionally suited Unsuitable	 Unsuitable Unsuitable Conditionally suited
Used in the pumps of series	SOGEVAC BI-series ≤ SV 120 BI (FC)	TRIVAC, SOGEVAC

Technical Data		LVO 700	DOT 4
ISO viscosity grade		32	Not classified[1]
Viscosity at 40 °C (104 °F) at 100 °C (212 °F)	 mm^2/s mm^2/s	 31 5	 Not applicable > 1.5
Flash point	°C (°F)	> 210 (> 410)	> 120 (248)
Density at 15 °C (59 °F)	kg/m^3	904	1070
Pour point	°C (°F)	< -42 (< -44)	< -50 (< -58)

Ordering Information	LVO 700	DOT 4
	Part No.	**Part No.**
1 liter	**L 700 01**	**200 10 037**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

[2] Not all EPDM materials are suited for contact with DOT 4

LEYBONOL Greases

Application Data	LVO 810 (LITHELEN)	LVO 870 (GLEITLEN)
Base oil type	Mineral oil	Special vaseline types
Thickener	Lithium soap	Natural rubber
Properties	Wide application range (0 to +150 °C (32 to 302 °F)), atmospheric pressure to 10^{-8} mbar	Usable down to 10^{-2} mbar
Application examples	Lubrication of ground joints, taps and O-rings at low pressures and high operating temperatures	Lubrication of stirrer shafts (KPG-stirrer)
Remarks	Owing high vacuum processing, LVO 810 does not contain any shares exhibiting higher vapor pressures [1]	–
Elastomer compatibility		
FKM (FPM, Viton)	Suited	Suited
NBR (Perbunan) [2]	Conditionally suited	Conditionally suited
EPDM	Unsuitable	Unsuitable

Technical Data		LVO 810 (LITHELEN)	LVO 870 (GLEITLEN)
Vapor pressure at 20 °C (68 °F)	mbar	10^{-10}	10^{-4}
Dropping point	°C (°F)	> 210 (441)	> 50 (> 122)
Max. operating temperature	°C (°F)	150 (302)	30 (86)

Ordering Information	LVO 810 (LITHELEN)	LVO 870 (GLEITLEN)
	Part No.	
Tube 50 g	**L 810 05**	**–**
Tin 50 g	**–**	**L 870 05**
Bucket 2 kg	**L 810 99**	**L 870 99**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] The product contains silicon dioxide

[2] Resistance is dependent on the level of the acrylonitrile content in the NBR

Application Data	LVO 871	LVO 872
Base oil type	Special vaseline types	Special vaseline types
Thickener	Natural rubber	Natural rubber
Properties	Usable down to 10^{-2} mbar	Usable down to 10^{-2} mbar
Application examples	Lubrication of ground joints	Lubrication of taps
Elastomer compatibility		
FKM (FPM, Viton)	Suited	Suited
NBR (Perbunan) [1]	Conditionally suited	Conditionally suited
EPDM	Unsuitable	Unsuitable

Technical Data		LVO 871	LVO 872
Vapor pressure at 20 °C (68 °F)	mbar	10^{-4}	10^{-4}
Dropping point	°C (°F)	> 56 (> 133)	> 56 (> 133)
Max. operating temperature	°C (°F)	30 (86)	30 (86)

Ordering Information	LVO 871	LVO 872
	Part No.	**Part No.**
Tin 50 g	**L 871 05**	**L 872 05**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR

Application Data — High Vacuum Grease

Base oil type	Silicone oil
Thickener	Inorganic
Properties	Low vapor pressure, high water and chemicals resistance
Application examples	Lubrication of ground joints, taps and O-rings at low pressures and high operating temperatures
Remarks	Wide operating range (-40 to +200 °C(-40 to +392 °F), atmospheric pressure down to 10^{-6} mbar) [2]
Elastomer compatibility	
FKM (FPM, Viton)	Suited
NBR (Perbunan) [1]	Suited
EPDM	Suited

Technical Data — High Vacuum Grease

Vapor pressure at 20 °C (68 °F)	**mbar**	10^{-7}
Dropping point	**°C (°F)**	None [3]
Max. operating temperature	**°C (°F)**	200 (392)

Ordering Information — High Vacuum Grease

	Part No.
Tube 50 g	**E 210 502**

Please note that the technical data stated are typical characteristics only. Slight variations from batch to batch must be expected. The technical data stated here do not entail any warranted characteristics

[1] Resistance is dependent on the level of the acrylonitrile content in the NBR
[2] This product is unsuitable if also hot-cathode ionization vacuum gauges e.g. IONIVAC ITR 90/200 are installed in the process
[3] Above 200 °C (392 °F) polymerisation of the silicone greases discharges gas

Notes

Miscellaneous

Services

We are offering a number of different services under the product designation LEYBONOL LVO 9XX.

These include oil analysis sets and application assessments.

Oil Analyses for Your Safety

An analysis of vacuum oils provides information on influences from the side of the process and can be an important component for quality assurance and process optimisation.

The mandatory reference analysis with a fresh oil sample completes the evaluation.

With the utilisation of LEYBONOL, no additional costs are incurred for this.

Please note that the oil samples must not be contaminated with explosive, microbiological or radioactive substances. When requiring the analysis of lubricants which are contaminated with toxic or corrosive media, you must first discuss this with our partner OELCHECK.

Oil Analysis Standard, Set 2

You receive from us one Analysis Set 2. You fill this set according to the instructions (minimum oil quantity is 60 ml) and send the oil sample and the consignment note directly to our partner OELCHECK. You will then receive the results directly from OELCHECK.

Application Data	LVO 900 Set 2 Oil Analysis Standard
Performance scope	Measurement of viscosity TAN (ageing) Wearing metals and additives in ppm Water in % Simple infrared measurement
Remark	Not applicable to PFPE oils

Ordering Information	LVO 900 Set 2 Oil Analysis Standard
	Part No.
Oil Analysis Standard, Set 2	**L 900 01**

Enhanced Oil Analysis, Set 5

You receive from us Analysis Set 5. You fill this according to the instructions (minimum oil quantity is 70 ml) and send the oil sample and the consignment note directly to our partner OELCHECK.
You will then receive the results directly from OELCHECK.
Especially recommended for trend analyses. Please order the corresponding number of sets.

Application Data	LVO 900 Set 5 Enhanced Oil Analysis
Performance scope	Measurement of viscosity TAN (ageing) Wearing metals and additives in ppm Water in % Simple infrared measurement Optical particle analysis and particle count
Remark	Not applicable to PFPE oils

Ordering Information	LVO 900 Set 5 Enhanced Oil Analysis
	Part No.
Enhanced Oil Analysis	L 900 02

Application Assessment

Application Assessment, Standard

You send to us the results of the analysis by our partner OELCHECK and complete the information on the laboratory order supplement. We will then compare this information with the information contained in our application database.
Thereafter you will receive a condition report and recommendations on how to handle and optimally use this type of oil in the desired process.

Ordering Information

LVO 900
Application Assessment, Standard

	Part No.
Application Assessment, Standard	**ASL 900 03**

Trend Analysis

You fill in the laboratory order supplement once and order three analysis, Part No. L 900 01 or L 900 02.
You then take the oil samples in cycles according to the recommendation from Oerlikon Leybold Vacuum yourself.
After completion of the analysis series you send all analysis results to us. We will then compare these results with the information in our application database.
Thereafter you will receive a condition report and recommendations on how to handle and optimally use this type of oil in the desired process.

Ordering Information

LVO 900
Trend Analysis

	Part No.
Trend Analysis	**ASL 900 04**

Forms are available on www.leybonol.com.

All recommendations on oil performance are based upon the information provided by the customer.
Standard Oerlikon Leybold Vacuum terms and conditions for services apply.

Glossary

Additives
Additives are oil soluble substances which can be added in low concentrations to the lubricants so as to improve certain properties. Frequently additives serve the purpose of improving, respectively avoiding oxidation, wear, corrosion, fluidity and foaming.
Not all additives are suited for vacuum applications. Some additives exhibit a high vapor pressure thereby having a negative influence on the attainable ultimate pressure.ÿ.

BAM
Some products from the LEYBONOL line have been registered at the Bundesanstalt für Materialforschung und -prüfung. (I.e. the Federal Institute for Materials Research and Testing in Germany.)

CFR (Code of Federal Regulations)
in the USA.

Colour
For this refer to “Visual appearance”.

Density
The density of a substance is defined as the ratio between its mass and its volume at a certain temperature. It depends on the chemical composition of a product.
International unit of measurement: kg/m^3

Dropping point
The dropping point designates the temperature at which a lubricating grease begins to flow.

Elastomers
Elastomers are cross-linked polymers capable of reversibly absorbing significant deformations. Elastomers are used as the sealing material for shaft sealing rings or O-rings, for example.
The following belong among others to the group of elastomers:
EPDM
Ethylene propylene diene monomer rubber EPDM
Usable up to 150 °C (302 °F), partly suited for glycol ether based brake fluids, not suited for mineral oils and ester oils.
FKM
Fluor rubber FKM (trade name VITON®, for example)
Usable up to 200 °C (392 °F), suited for mineral oils and ester oils, not suited for glycol ether based brake fluids.
NBR
Acrylonitrile-butadiene rubber NBR (trade name PERBUNAN®, for example)
Usable up to 100 °C (212 °F), only NBR with a high share of acrylonitrile is suited for mineral oils and ester oils, not suited for glycol ether based brake fluids.

FDA (Food and Drug Administration)
Food and Drug Administration in the USA responsible for the approval of substances on the US American market.

Flash point
Flash point is the lowest temperature at which a liquid which is to be tested develops vapours in an open, respectively sealed crucible to such an extent that this vapor/air mixture above the liquid level can be briefly ignited by an external ignition.

Foaming
It is normal for oils in vacuum pumps to foam slightly upon the ingress of air through the gas ballast, for example. Under normal conditions this will not have any effect on the pump’s performance.

Infrared measurement (IR)
Through the natural vibrations of the atoms of certain groups of organic molecules, the energy of the emitted infrared light is absorbed to different extents.
Based on an infrared spectrum it is possible to assess the following criteria among others:

- Detection of the type of oil (mineral oil, ester oil, PFPE, for example) by comparison against reference spectra
- Detection of contaminants in comparison with the fresh oil spectrum

ISO viscosity grade
Classification of liquid industrial lubricants in 20 viscosity grades based on the kinematic viscosity at 40 °C (104 °F) in the range of 2 mm^2/s to 3200 mm^2/s.
Abbreviation: ISO VG
See Table 1.

Neutralisation number
The neutralisation number indicates the quantity of potassium hydroxide (KOH) required to neutralise the free acid constituents contained in 1 g of a lubricant. Through the neutralisation number it is possible to determine the relative changes for used lubricants suffering from oxidative ageing. The increase in the neutralisation number in combination with the viscosity change are needed to assess the oil quality.
See also “TAN”.

NSF (National Sanitation Foundation/ Nonfood Compounds Registration Program)
Nonfood components registration program for all substances used in the food industry like lubricants, for example.

Odour
Lubricants when new exhibit a mild odour. Mineral oils will usually develop a more intensive odour compared to synthetic oils. Contamination with foreign substances or lubricant reactions can cause a significant odour change.

Oil ageing
Common lubricants cannot be used for an unlimited time.
Lubricants worsen during use, i.e. they age. This ageing is caused, among other things, by temperature, oxidation, chemical and physical reactions with process media. This can result in the formation of sludge, resins or acids (for this see also Chapter “General information and Recommendations for Oils”, paragraph “Oil check”).

Pour point
The pour point is the lowest temperature at which oil is still capable of flowing.

RoHS (Restriction of (the use of certain) hazardous substances)
Directive on the Restriction of the use of certain Hazardous Substances in electrical and electronic equipment.

TAN
The designation TAN (Total Acid Number) is frequently used instead of the designation neutralisation number.
For details see “Neutralisation number”.

Thickener
A thickener binds the oil in the lubricating grease and may increase lubricity or thermal stability of the grease.
Thickeners are roughly categorised in soap thickeners like lithium and non-soap thickeners like polyurea or PTFE.

USDA
United States Department of Agriculture (in charge of food safety among other things).

Vapor pressure
The vapor pressure is the ambient pressure below which a liquid begins to change in to the gaseous state with the temperature being constant.

Viscosity
Viscosity is a measure of the amount of inner friction within a fluid. The development of hydrodynamically supporting films of oil, optimum oil conveying, sealing and lubricating and also the supply of heat require optimum viscosities. These need to be within certain ranges depending on the specific purpose of the application.

Viscosity is much temperature dependent.
At increasing temperatures viscosity reduces, i.e. the lubricant substance is less viscous.

When the oil is too thick at operating temperature it will no longer flow through the oil lines resulting in inadequate lubrication thereby causing damage. The result is a rapid increase in wear and an impaired ultimate pressure.

During operation the viscosity may change owing to:

- Lubricant ageing
- Ingress of foreign substances
- Reaction of the lubricant substance with the process media

a) Dynamic viscosity
The Newtonian definition of viscosity relates to the true viscosity. It is also termed dynamic viscosity.
International unit of measurement: mPas
This value corresponds to the former unit of measurement: cP

b) Kinematic viscosity
The ratio between dynamic viscosity and density is defined as kinematic viscosity. Generally kinematic viscosity is measured at 40 °C (104 °F) and 100 °C (212 °F).
International unit of measurement: mm^2/s.
This value corresponds to the former unit of measurement: cSt.

Visual appearance
The visual appearance of the lubricant should be clear and clean. The colour of the new lubricant substances will normally range from colourless to amber. Changes in colour and turbidity can be indicative of a contamination with foreign substances or oxidation. Turbidity, for example, may indicate the presence of water. However, the colour alone is not conclusive as to the condition of the lubricant.

VOC
Volatile Organic Compound.

Water
A high water content can impair the lubricity of the lubricant being used and may have a negative influence on the attainable ultimate pressure.
Should the oil/water emulsion remain in the pump then this can lead to corrosion.

Wearing metals
Wearing materials like iron, aluminum copper can be detected by measurements. Wearing metals present in the oil allow conclusions as to abrasive or corrosive wear.

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LEYBONOL Oil Analysis

Laboratory Order Supplement

Please cross as appropriate

- ☐ Application assessment: Standard
- ☐ Application assessment: Trend analysis
- ☐ Condition assessment
- ☐ Matching the oil selection to the application
- ☐ Optimisation of oil change intervals
- ☐ Review of accessories, effectiveness of filtering devices, for example (for trend analysis/Set 5)

Customer

Company *

Name *

Street address/number *

Postal code/city *

Phone *

E-mail *

Oil sample

Oil designation *

Oil manufacturer or supplier *

Used in pump type/size *

Total oil sample operating hours *

Total pump operating hours

Oil change interval

Oil temperature

Pump accessories *

Application *

Process media *

Reason/problem/aim of the investigation *

Please fill in all fields marked with an *.

Please note that in the instance of missing information, in particular in the case of a missing description of the problem, an optimal assessment will not be possible.

Please return the filled-in laboratory order supplement to:
analysis.leybonol@oerlikon.com

Forms are available from our homepage www.leybonol.com.

We provide our service on the basis of the information submitted by you. Our general sales terms for services apply.

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leybold vacuum

www.oerlikon.com/
leyboldvacuum

Table 1

ISO viscosity grade	Centre point for the kinematic viscosity (mm²/s at 40 °C (104 °F))	Limit values for the viscosity grades (mm²/s at 40 °C (104 °F)) min. / max.
ISO VG 2	2.2	1.98 / 2.42
ISO VG 3	3.2	2.88 / 3.52
ISO VG 5	4.6	4.14 / 5.06
ISO VG 7	6.8	6.12 / 7.48
ISO VG 10	10	9.00 / 11.0
ISO VG 15	15	13.5 / 16.5
ISO VG 22	22	19.8 / 24.2
ISO VG 32	32	28.8 / 35.2
ISO VG 46	46	41.4 / 50.6
ISO VG 68	68	61.2 / 74.8
ISO VG 100	100	90.0 / 110
ISO VG 150	150	135 / 165
ISO VG 220	220	198 / 242
ISO VG 320	320	288 / 352
ISO VG 460	460	414 / 506

In acc. with DIN ISO 3448, as of February 2010

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